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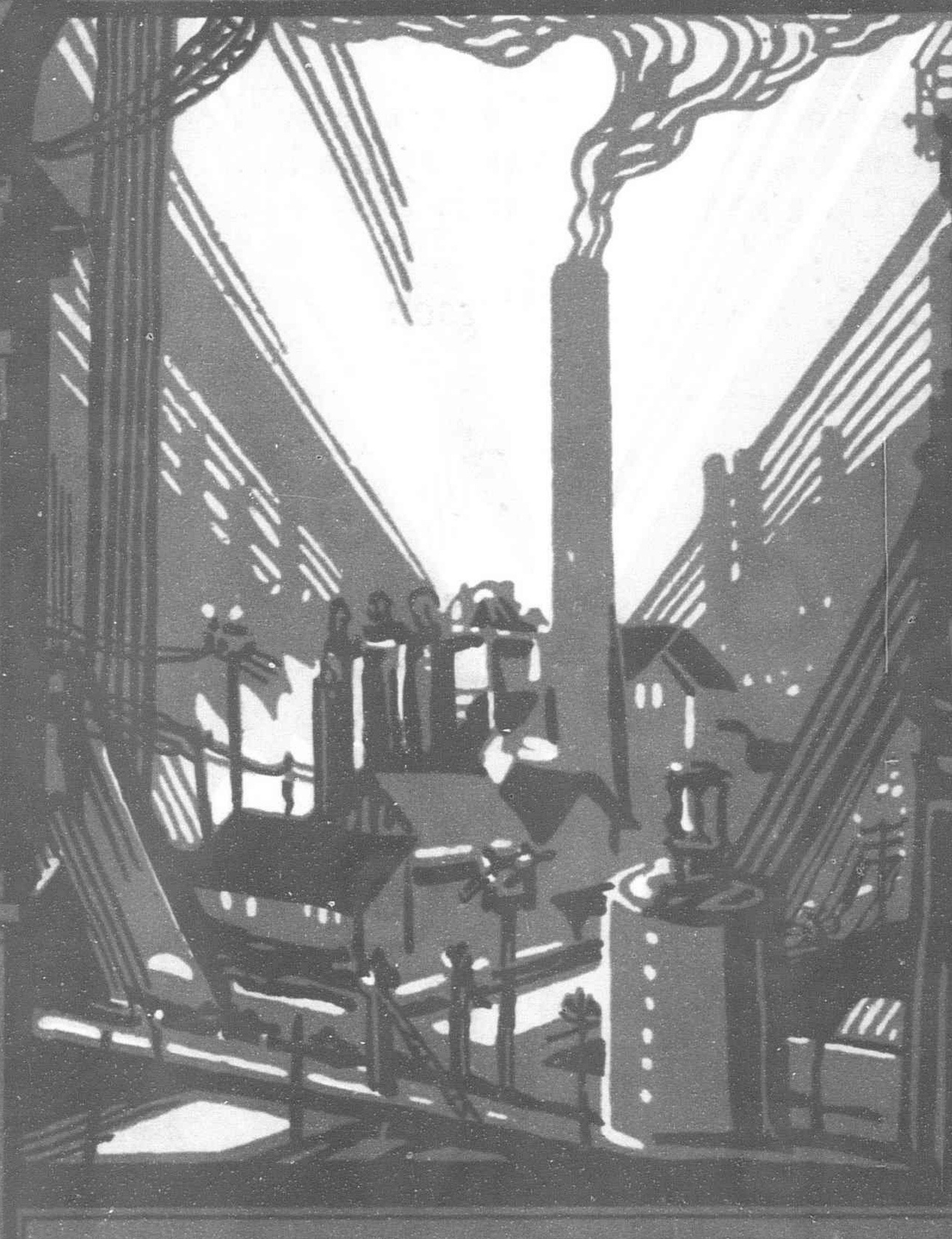

上海黃浦灘念四號

遠東時報

THE SOUTH MANCHURIA RAILWAY; ITS GREAT MISSION AND WORK

THE JAPAN-AUSTRALIA TRADE DISPUTE

HOW TO MAKE GRAVEYARDS

Vol. XXXIII

JUNE, 1937

No. 6

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ENGINEERING FINANCE COMMERCE

VOL. XXXIII SHANGHAI, JUNE, 1937 No. 6

How to Make Graveyards

By C. J. LAVAL

IN the still night watches before the dawn they can be seen—grey shadowy lines of men flowing swiftly through the streets of sleeping cities with only the rhythmic sound of foot-beats breaking the silence. These runners of the night are like athletes preparing for conflict, and in their hard training they display a grim doggedness and seem imbued with a fierce determination to attain a distant goal. They are not athletes, however, in the true sense. They are soldiers, and they may be seen, at times loaded heavily with their fighting gear, at times stripped to simple garments, in all weathers, at Nanking, and in every other center in China where large bodies of Chinese troops are stationed.

This small detail of military training is perhaps the least part of the extensive military preparations being made, in the schools and the homes, and in the minds and the hearts of many people of all walks of life in China. It is not intended by any means to imply that intensive military training is a thing peculiar to China alone in the Far East. It is doubtless desirable and admirable in ordinary aspects, but with the new emphasis and acceleration given it in recent times in China, it is a symptom of a malady spreading dangerously in the country. With regard to causes it is a waste of time to consider the so-called moralities, the rights or the wrongs, of things in China. Just at this time these measure into futilities and analysis or arguments on such lines lead nowhere. The plain practicalities of the outlook tend to indicate that the Chinese genius for turning small successes into great disasters once again is striving to find expression.

China emerged from the Washington Conference in 1922 with about everything she wanted and asked for and with the blessing of the great powers, for these powers bought heavily and paid for "*futures*" *on China with high hopes that the investment would* yield returns. In the years that followed, younger leaders appeared on the scene, each with a diploma from overseas and a nice new fountain pen. They blazed with zeal and, scorning guidance, they set out to place China overnight in the forefront of the great world powers. Their elders who had toilsomely laid the foundations of the new order in China went unheeded, and they relegated Dr. Sun Yat-sen to the background as a visionary and a dreamer. They pyramided their winnings at Washington and pressed their luck without regard for hazards. Like Kipling's monkey that had "too much ego in his cosmos" they misjudged a spirit of hopeful conciliation on the part of outsiders for fear and apprehension and so got themselves into a state of mind not unlike that of the Chinese Emperor in the middle of the preceding century who received the first British Ambassadors to his Court with the naive delusion that they were tribute bearers from an overseas vassal state.

History in the 'Twenties

The underlying reasons for the grants that were given and for the prestige that was bestowed on China at the Washington Conference were set forth clearly in the treaties that were written at that time. These special favors, from the American standpoint at least, were accorded with characteristic American altruism and friendliness, along with pious hopes for commercial profits that have continued to this day to be just hopes. As they misinterpreted the purposes of the treaties, these Chinese leaders were contemptuous of them, and with utter disregard for China's own commitments in the treaties, they ran rough-shod in a headlong course marked by anti-foreign movements and boycotts and a truculent disdain for all remonstrances, at the same time disrupting the country with the destructive long drawn-out civil strife of conflicting jealous factions. They really attained remarkable lengths; it is said that some seven years ago a draft agreement implying abolition of extra-territoriality was initialled by the representative of one of the great powers whose example in such a course necessarily would have been followed by the rank and file of foreign powers in China.

Japan was the nation nearest to all this turmoil and the most vulnerable. A time came at length when Japan, rightly or wrongly, deemed that her own existence was endangered. She acted. Followed then the Manchurian incident, the emergence of the State of Manchoukuo and all the other consequences that have brought about the unrest and controversies of the present day. If the blame for present-day conditions in China is to be assessed, for accuracy, if not in fairness, the events of this earlier era in the 'twenties should be considered, despite all the findings of the Lytton Report to the League of Nations and the utterances, letters and speeches of Colonel Henry Stimson, former American Secretary of State, and parent of the "Stimson Doctrine."

Some seventeen years ago when he was planning the strategy of one of the northward sorties out of Canton, Dr. Sun Yat-sen called upon his followers to suggest plans for the campaign he had in mind. One of the least known figures of the Commander's military entourage had the effrontery to submit a plan of action along with the others sent in by divisional commanders and other high officers. The older militarists smiled indulgently about this. They were sure that the young officer's papers, which bore the obscure name of Chiang Kai-shek, would be ignored and disregarded. The methodical Commander-in-Chief, who had the "genius of taking infinite pains," examined closely all of the plans that were submitted, however. He discerned the great talents then dormant in his young subordinate and it is said that this almost forgotten incident was the first important step that Chiang Kai-shek took on the long climb that has brought him to the eminence he occupies so deservedly to-day

The Record of Chiang Kai-shek

It has been under the guidance of Chiang Kai-shek that the greatest degree of unification of China since the overthrow of the Manchus has been achieved. He dissipated the strength of the rebellious communist forces and drove this alien influence from the important strategic centers it occupied. With unflagging energy he has encouraged and pushed forward all the varied phases of reconstruction work of recent years and while doing these things, as Commander-in-Chief of China's armies, he has built up the most impressive and powerful military machine the nation has ever had. What, perhaps is the surest evidence of the man's real greatness, is that through all this time of swift progress he has kept his feet firmly on the ground and, profiting by the mistakes of past leaders, steadfastly has remained a practical realist, seeing things clearly as they are and not as he and others would wish them to be.

To do this has required uncommon strength of character, for he has had at once to resist and control a veritable hysteria of such bitter opposition that more than once his life has been placed in

jeopardy. He has gauged with scientific precision the dire consequences to his country of armed conflict with Japan, and judged accurately values of external influences, discounting all the usual assurances volunteered from alien sources with special ends to serve and without practical concrete backing. Most difficult of all, he has had to placate an uninformed popular clamor, which, with support in high places, blindly has been bent on national suicide, and has opposed the pressure thus exerted with firm refusal to sacrifice his people. This pressure, in recent times, has reached such intensity that it has become questionable if Chiang Kai-shek may not in spite of everything be compelled to yield.

Chiang Kai-shek is aware, as every intelligent observer is aware, that with all of the great military power that China has built up, she still is decades away, in force and in resources, from any hope of conquering Japan in warfare. Sensibly, therefore, Chiang Kai-shek has been facing this difficult situation with cool judgment, using no small part of his energies merely to control his own people and save them, ever striving to effect adjustments that will permit him to enlist time as his great ally.

The belief entertained, even by elements within the Nanking Government, that China could destroy Japan is based on a callous disregard for the lives and the welfare of China's masses. This belief rests on the theory that in case of war China's armies could retreat to distant interior fastnesses into which Japanese armies would be lured in vain pursuit. Japan then, these sophists say, would exhaust her resources, bringing about her internal collapse, just at a time when Red Russia would attack.

Japan has no wish for conflict of any sort, and she has done and said everything possible to make this plain. Assuredly she would not invite Occidental opposition by any ill-considered military adventure aimed against China. If war is forced upon her by China, however, this circumstance itself would equip her to make necessary adjustments regarding China's coast and ports with interested Occidental powers, and in such circumstances who could think that she would embark on the mad enterprise of sending armies to chase a will o'the wisp into the far interior of China to thus destroy herself ?

Sidelights on the Sian Affair

All of the causes and the background of the so-called " Sian Coup " remain more or less obscure, but if in future the truth is made known about the seizure and detention of the person of Chiang Kai-shek last December and his subsequent release, then it is probable that historians will have to write that China was saved at this time by a woman. To what depths—or heights—the plot of the crime at Sian extends has not been made known. It was the utterly unexpected thing, the flaw that criminologists assert is a part of every crime, however well planned, that upset the purposes of those who planned the Sian affair. This unexpected element that was never dreamed of by the conspirators was the action taken by Madame Chiang Kai-shek. The purpose of the thing stands clearly revealed. This was the elimination from the scene in China of Chiang Kai-shek so that his firm control of the affairs of the nation might be transferred into other hands. His removal would have unleashed every unbalanced element in the country and would have put the nation on a course leading to inevitable destruction. How well Madame Chiang Kai-shek understood this situation she tells herself in the book she recently has produced, " Sian : A Coup d'Etat." The book itself, by the way, is an added clever thrust against the interests opposed to her husband.

Through the first few days after the world learned that Chiang Kai-shek had been made captive at Sian it was not known whether or not he had been killed. Militarists in Nanking took the view that an attack in force should be launched against the rebellious troops in Sian, and they held to this opinion when it was urged that such an attack against Sian would mean the certain death of the Generalissimo, if he still lived. Madame Chiang Kai-shek relates in her book how she hurried to Nanking and did everything in her power to prevent the planned move against Sian. The opinion was expressed that the life of one man could not be weighed against the prestige of the State and the taunt was thrown at Madame Chiang that " she was only a woman pleading for the life of her husband." Let her answer in her own words :

> " I am a woman," I retorted, " but I am speaking not as a wife trying to save her husband's life. If it is necessary that the Generalissimo should die for the good of the country, I would be the first one to sacrifice him, but to my mind, to use military force and to attack and bombard Sian would not only endanger the life of the Generalissimo, who is a universally recognized leader of the country, but would also cause untold misery and suffering to thousands of innocent civilians, as well as waste our military force, which should be conserved for national defence. Let us see whether or not any channels are open through which we may come to a peaceful settlement."
>
> " Believe me, gentlemen," I continued, especially addressing high military and party officials, " when I tell you that I am making this appeal to you, not as a woman thinking of the safety of her husband, but as a citizen taking a dispassionate and realistic attitude to secure the least costly solution of a great national problem. In no circumstances would I hesitate to sacrifice myself and my husband if such a sacrifice could be of the least benefit to the nation. But what you are proposing to-day actually endangers the life of the Generalissimo, and since in the mind of the people, as well as in my own mind, the Generalissimo's safety is inseparable from the continued unity, and even existence, of the nation itself at this critical period of our history, no effort should be spared to secure his release by peaceful means. Place the armies in position if you so desire, but do not fire a single shot."

Events After Sian

Owing to the efforts of Madame Chiang a respite was granted and the attack against Sian was held off for a space. The world has read how in the time thus gained Madame Chiang flew in an airplane to Sian to join her husband in captivity and, if the need arose, in death. She was thus enabled to return with him to Nanking after his release.

The outcome of the affair at Sian has not brought any marked changes in general conditions within China. The forces that sought to remove the steadying influence of Chiang Kai-shek remain unchastened and watchful for new opportunities for mischief while the clamor for war with Japan persists. Certain external events may have been influencing the situation somewhat. Dr. H. H. Kung, the former Minister of Finance, after attending the Coronation ceremony in London, has been cutting quite a wide swath through the Capitals in Europe, and the numerous press dispatches regarding his activities and his European contacts, innocuous though they seem, have been received in China by special interests who have adapted these news reports to special purposes.

The much publicized Anglo-Japanese discussions came under special notice just at the time that Dr. Kung visited London. In connection with the Anglo-Japanese talks both Great Britain and Japan were at pains to affirm that, in connection with any matters relating to co-operation in China, China's own interests and rights would be safe-guarded and respected. Sir Anthony Eden and other British statesmen undoubtedly told Doctor Kung these same things, and in the telling probably they would not have refrained from emphasizing Britain's great friendship for China, evidenced in recent times by the extensive assistance Britian has given to China in general reconstruction work and in effecting financial arrangements. Such conversation might well have touched also on the great work on the British Naval Base at Singapore along with references to strengthened armaments at Hongkong. Such details, duly reported to his Government by Doctor Kung, were capable of being given varied interpretations and meanings measuring into assurances that the original spokesmen back in London never dreamt of. These things have been made to serve an end in China, however.

What Mussolini told Doctor Kung may not be specially relevant, for Italy's interests and influence in the Far East are slight. In Berlin, though, assuredly the visiting Chinese statesman and financier was welcomed warmly and treated with every kind consideration, for German trade in the Far East is expanding swiftly, at the expense of Britain and the United States, and Messrs. Goering and Hitler would never pass this opportunity to emphasize Nazi German's good-will toward China. In the natural course of their talks they would be expected also to touch on subjects of current interest such as the recently concluded Japanese-German treaty, but nothing that could possibly be displeasing to China would be said in this or in any other connection. From such a beginning, or, possibly from some different source, a belief has taken form in

(Continued on page 250)

The Japan-Australia Trade Dispute

By C. A. S. HAWKER, M.H.R.

(The author of the following lucid and temperate review of the recently adjusted trade controversy of Japan and Australia, was Minister of Commerce of the Commonwealth in 1932, and is a member of the House of Representatives for Wakefield (S.A.). The article is taken from the initial issue of the new publication, *The Austral-Asiatic Bulletin*)

To many people the dispute at first seemed incomprehensible. The value of Japanese purchases of Australian raw materials, both during the depression and afterward, and the complementary value of the raw materials to the Japanese themselves formed a solid basis for good understanding. Goodwill missions, led respectively by Sir John Latham and Mr. Debuchi, had given public emphasis to friendly sentiments. In this favorable atmosphere negotiations were in progress for a trade agreement which, it was hoped, would cement the neighborly feeling and consolidate the valuable trade between the two countries. Then, to the surprise of the Australian public, no trade treaty materialized but a dispute broke upon them like a storm from serene skies.

A deadlock had been reached. To end the deadlock and to establish a new basis for negotiations, the Australian Government tabled a tariff schedule by which duties upon cotton and rayon goods were altered from *ad valorem* percentages to specific rates. Although this did not increase the average rate of duty nor technically discriminate against Japan, it did in fact operate to the serious disadvantage of the cheap goods which formed the bulk of Japanese trade. The Japanese not unnaturally treated the tariff as an injury and retaliated—at first by an unofficial boycott and soon after by tariff surcharges and import licenses. Australia, rather unexpectedly, counter-retaliated and almost before the public, or even Parliament, realized that trouble was brewing, both countries were fairly at it, with the whole East watching for the result.

How long could a small country stand the stress of losing a great customer for her leading export? Would Australia cave in, like Canada? What penalty would be exacted in future if Australia did not stay the course and thereby made it obvious that she lay at the mercy of her powerful customers? Such questions superseded estimates of the value of trade items as the issue. In face of them most Australians swung into line and, perhaps with tacit reservations for the future, stood by their government until the dispute was ended by a fair compromise.

Now that the dispute is settled, the main interest in examining it, is to seek experience which may help the two countries to avoid any recurrence. To begin with, there was not, and there is not now, any territorial or racial question at issue. The deadlock was entirely a trade issue. The settlement of the dispute has proved that it was not absolutely irreconcilable. Until the time comes for all the documents to be published it is possible only to draw deductions, probably imperfect, as to what were the wrong assumptions upon which conflicting objectives were based, or as to what were the misunderstandings and strokes of bad luck which contributed to the breach. It is, however, reasonably clear that in each country imperfect knowledge of the special problems of the other had given rise to assumptions which were so wide of the facts that it would have been almost impossible to reconcile them by mere discussion, until some test had cleared up the wrong premises.

Each Government was acutely aware of its own country's difficulties and but dimly conscious of those of the other. The means to rectify its own seemed so obvious and reasonable that determination to obtain redress grew naturally. The quantities of wool, wheat and minerals which Japanese bought in Australia had never been more than part paid for by direct exports to Australia. Australian materials were so important to the Japanese that they used credits derived from exports to other countries in order to purchase them. It was a case of triangular trade. Australians saw a very satisfactory export of wool, wheat, tallow, minerals, etc., along one side of the triangle and did not concern themselves as to how the Japanese were getting on along the other sides, from which so much of their payments were drawn. Actually the Japanese were meeting with constant difficulties. Some dozens of countries were imposing trade restrictions against their goods. Wherever the Japanese had a favorable trade balance they found it particularly vulnerable to hostile quotas. This painful experience, and the reasonable logic of the position, drove them to make good any set-backs by a corresponding pressure of exports where, as in the case of Australia, a favorable trade balance of the other country seemed a hostage for welcome, or, failing welcome, placed the thick end of the bargaining stick in Japanese hands.

Although it was quite well understood in Australia that Japan needed exports to enable her to buy imports, it was but dimly comprehended how credit difficulties had filled the public mind in Japan with an almost feverish sense of urgency of making overseas sales. What the Australian Government became very conscious of was an intense pressure by Japanese shipowners and exporters against all their competitors. Prices were cut below any reduction necessary to win orders. It seemed like a national drive to annihilate all competition. There was some evidence of government backing. The spectacular rout of Lancashire made the Ottawa preference seem farcical. It raised an alarming doubt of security for the future of those reciprocal British preferences upon which the prosperity of Australia's intense-culture industries depend. Trade with other countries was also upset. As imports from them diminished, the base which they formed for a pyramid of credits to buy Australian products shrank likewise. As Japanese sales grew at the expense of other countries the competition for Australian wool, etc., narrowed. What the Japanese appear to have failed to understand was that no growth of their purchases of wool and minerals alone could ever make good to Australia a loss of other markets which took, as well as wool and minerals, fruit, dairy produce, meat, sugar and wine, for which there is no other prospective outlet.

The adverse current was running strongly and initiative was therefore forced upon Australia. There was at first diffidence and delay, caused by the sincere desire for goodwill. When, at last, the delicate matter of trade regulation was intruded into the otherwise promising negotiations, matters had drifted to a point at which the Australian Government felt considerable rectification was necessary. There will be differences of opinion whether curtailment of the peak volume of exports, as distinct from a halt, was really necessary; but it is almost certain that either suggestion would have caused similar surprise and met with the same complete rebuff. Actually the Japanese trade difficulties elsewhere had created such a public feeling of the urgency of winning exports that they could brook no curb in markets where the size of their purchases appeared to give them the commanding word. So the deadlock occurred, with the Australian Government not fully aware of the lengths to which their temper might carry the Japanese in stinting their own comfort in order to economize wool if a dispute arose, and with the Japanese quite unaware of the transcendent importance to Australia of other markets or of the extent to which commodities such as wool and minerals can find alternative buyers at the cost of relatively small price sacrifice. Once these facts were made plain by hard experience, the arrangement of a fair compromise became a reasonably certain event.

Beside the main divergence of opinion a number of minor misunderstandings, strokes of bad luck and irritants occurred which provide further illustration of the great difficulty which any Australian Government must have in conducting harmonious relations with foreign countries until there is a much larger service to keep it informed, and also a better informed public opinion to back it up.

To take one instance of bad luck. The question of trade rationalization was raised by Australia just before the attempted *coup d'etat* by young army officers in February, 1936. It had to be dealt with by a Japanese Government whose main task was to clean up the precarious internal situation. It was the last defence of Constitutional government. In hardly any circumstances could it have accepted trade curtailment which might have appeared in Japan as a meek concession to international influences. One can

scarcely imagine a more unpropitious time for the Australian request for trade regulation to be pressed, but we have almost no means in Australia of ascertaining such things in advance, and we make little use even of those which we have.

On this occasion, the Government was more in the dark than usual. A well intentioned effort to safeguard the British Government from incurring any odium from a possible dispute led the Australian Government to refrain from consulting it in advance. This was a double misfortune because it not only deprived our Government of the magnificent expert advice and diplomatic service of the British, but in itself it seemed so uncircumstantial that so far from winning credence in Japan it was widely believed to be a rather crude mis-statement intended to cover supposed dictation by the British Government.

The Japanese have a splendid foreign service and have been represented in Australia by men of outstanding merit. Nevertheless, in Japan itself there seem to be very strong and ill informed influences which sometimes dictate actions that unnecessarily hurt the susceptibilities of other people. One instance, and by no means the most serious of those which occurred during the negotiations which preceded the dispute, was the Japanese disregard of probable Australian reactions to the inspired press campaign during April and May of last year. That was directed against possible tariff action in Australia long before any such action had been taken. It was both intemperate in its threats and obviously well informed by official leakages about the course of confidential negotiations. Possibly it was to break gently to the Japanese interests likely to be affected the fact that promising negotiations had suddenly headed for a break. It may have been intended to stimulate Japanese sentiment to stand up to the loss and inconvenience of a pending dispute. Possibly it was hoped that it might reach the Australian public over the head of the Government, which had given it no hint of brewing trouble. Whatever its motives, it must have seemed to Australian Ministers such a betrayal of confidential communications that further negotiation was futile. It inevitably contributed to the precipitation of the dispute.

The bright spot which transcends all the gloom is the fact that the dispute has been settled. In Australia there is a sincere desire to do all that is reasonably possible to restore goodwill again and to increase it for the future. The lesson of the differences and misunderstandings of the past is plain. It is certainly not that by changing any particular minister trouble can be avoided for the future. There are few Australians who have as wide acquaintanceship with other nations as Sir Henry Gullett or who show as much courtesy and consideration for other people. Criticisms in this article are not directed against him personally. The fact is that any Australian Minister who has to negotiate upon important matters with foreign Governments must face his task with the minimum of useful information and helpful backing. As a nation Australia must become better informed about the difficulties and special feelings of her neighbors. Her embyro overseas services must be strengthened and, what is more important still, be made more use of than in the past. But a well informed public opinion is at least as important, and all who are anxious that Australia shall be on the best possible terms with her neighbors must welcome the appearance of *The Austral-Asiatic Bulletin* as a contribution toward it.

New Technical Journal Appears

A NEW publication which will be received with special interest in the electro-technical world in the Far East and overseas as well, is the *Electrotechnical Journal*, which is to be published monthly by the Institute of Electrical Engineers of Japan. In a foreword opening the June issue of the new journal, Dr. Takeshi Nishi, Professor of Electrical Engineering, Tokyo Imperial University and President of the Institute of Electiral Engineers of Japan, explains that "intimate contact between Japan and other countries has been greatly handicapped by the barrier of conspicuous difference in language," which, he says, it is desirable to surmount in an endeavor to bring about deeper mutual knowledge and clearer understanding, and to contribute, if only a little, to international good-will.

It is with this aim, Dr. Nishi asserts, that the Institute of Electrical Engineers of Japan has tried, since 1921, to inform overseas countries of the studies and technique of electrical engineering in Japan. Through recent years abstracts of important papers in English have been added to the monthly home edition of the Institute's journal and distributed abroad. It has now been decided, however, in order to better attain the purposes of the Institute, to amplify these abstracts of original papers, presenting more detailed information, and this is to be done in the new publication, *Electrotechnical Journal*, which is to appear monthly.

Facts About the "Denki-Gakkwai"

The Institute of Electrical Engineers of Japan, called the *Denki-Gakkwai* in Japan, was founded on June 25, 1888—very nearly 50 years ago. Its primary objects are the advancement of the theory and practice of electrical engineering and of allied arts and sciences, and the promotion of a high professional standing among its members.

The Institute has contributed greatly toward the remarkable progress that has taken place in Japan in the electrical field during the past half century, and has always been an important factor in advancing the interests of its individual members and of the entire engineering profession in Japan.

The Institute publishes its official monthly publication, entitled *The Journal of the Institute of Electrical Engineers of Japan* in Japanese; this is called the *Denki-Gakkwai Zasshi*, in Japanese, approximately 9,000 copies per issue being printed. This is the most authoritative organ of all publications relating to electrical engineering in Japan. It contains 1,500 pages a year of the papers on highly professional and extremely fundamental researches and applications in the electrical field.

In addition, the new overseas edition in English is published regularly every month, beginning with the June, 1937, issue.

A number of other publications are compiled and published by the Institute in Japanese. Among them the publication of the so-called "Electrical Engineering Pocketbook"—really a handbook which is comparable to the Standard Handbook for Electrical Engineers.

Standardization

A national Committee named the Japanese Electro-technical Committee was formed within the Institute in 1910, and it joined the International Electro-technical Commission which is known as the I.E.C. This Committee carries on the work of standardizing various electrical machinery and apparatus, nomenclature, symbols, and so forth in Japan, covering practically all branches of electrical engineering. At present 16 different committees are meeting regularly once every month, or sometimes even more frequently, and roughly 50 standard specifications have already been drafted and approved. Some of them are translated into English by this Committee for international use.

The Institute awards annually a certain sum of money to its members for their fundamental research work of value. A total sum of Y.32,000 in cash has been bestowed for 55 different subjects.

The Institute select annually a most distinguished electrical engineer among its members. A sum of Y1,000 is awarded as prize for his excellent work achieved. Since 1926, twelve persons have been chosen for this purpose.

With the aid of the Iwadare Foundation, the Institute invites American authorities for lectures in Japan, and sends Japanese electrical engineers to the United States of America for further study there for about one year. Interests accruing from Y.500,000 which was donated to the Institute in 1929 by Mr. K. Iwadare is utilized for this purpose.

International Relation

The Institute has made reciprocal arrangements for the exchange of privileges as to visiting members, with the American Institute of Electrical Engineers, The Institution of Electrical Engineers (England), and "Société Francaise des Electriciens."

Through the Japanese Electro-technical Committee, the Institute is carrying on a lot of international work regarding standardization of electrical machinery and apparatus, nomenclature, symbols, prime movers, electrical materials, etc., by joining the I.E.C.

Whenever there is held an international congress or plenary meeting of importance abroad, the Institute has never failed to send a delegation and to present papers at such a congress or meeting.

At present the membership of the Institute is about 8,500, and it is steadily increasing. All branches of electrical engineering are represented in the membership.

The South Manchuria Railway Company; Its Great Mission and Work

By YOSUKE MATSUOKA in "Contemporary Manchuria"

BREAKING the breathless tension of the Russo-Japanese War of 1904-05, in which she staked not only her national existence but the destiny of all races in Eastern Asia, Japan emerged victorious, but only at enormous sacrifices entailing the loss of one hundred and twenty thousand precious lives and the expenditure of two billion yen. As the result of her hard-won victory, Japan obtained the lease of the Liaotung Peninsula, now known as the Kwantung Leased Territory, and also gained possession of the railway between Port Arthur and Changchun (Hsinking) built by the Russians as an instrument of Russian Imperialism, its branch lines and the coal mines along them. It was to utilize and develop these railways and collieries that the South Manchuria Railway Company came into existence.

The railroads which Japan took over from Russia were in a deplorable condition; they consisted of single tracks with exceedingly poor roadbeds and rails broken in many places. All the rolling-stock had either been withdrawn to Russian territory or destroyed, and the bridges blown up by the Russian troops during their retreat. Furthermore, the coal mines had been worked in such a primitive and inefficient manner that their real value was quite unknown. The vast territory along the railways had also been left undeveloped and uncultivated. The fruits of Japan's hard-won victory, in a word, appeared so poor and unenticing that every business man in Japan at that time doubted the sagacity of investing capital in the enterprises taken over from the Russians, the economic value of which seemed so dubious.

But not for a moment could the leaders of Japan forget the Russian designs on Manchuria which had forced Japan to take up arms in self-defence. They suspected that, defeated though she was, Czarist Russia would sooner or later strike back at the island Empire in revenge. To prevent the outbreak of another war, they were convinced that Japan must consolidate her position in Manchuria and make herself all powerful in her new sphere of influence. For this they believed that the fullest use must be made of the properties and rights ceded by Russia in order that the greatest possible economic opportunity and encouragement might be offered for the settlement of as many Japanese as possible in the new land, and for the launching of all sorts of enterprises by such settlers. As a medium through which the development of Manchuria could be undertaken, the leaders of Japan proposed to form an influential institution, like the East India Company, whose pioneering work in Manchuria would be supported by the nation at all cost as an undertaking indispensable to the protection of Japan's life-line on the Asiatic continent.

Thanks to their foresight and courage, the establishment of the South Manchuria Railway Company was thus decided upon. In order to allay any anxiety among the public as to the future of the Company and to insure adequate financial backing for the firm, an Imperial ordinance was promulgated in which the Government guaranteed a dividend of six per cent on the paid-up capital of the new corporation as well as guaranteeing the payment of interest on its debentures and the repayment of principal.

Thus, with a strong appeal to the people to support this national project, S.M.R. shares were offered for subscription. To the pleasant surprise of the sponsors of the project, the shares were oversubscribed more than 1,077 times. No stronger evidence than this could have been adduced to prove that the nation was united as one in its desire to complete the task which Japan had undertaken in the war with Russia, so that the sacrifice of one hundred and twenty thousand lives would not be in vain.

It was under such auspicious circumstances that the South Manchuria Railway Company was formally launched as a unique concern with a special mission to perform. And from the very beginning the executives of the Railway Company have always proved themselves loyal to its mission, investing huge sums of capital, regardless of the financial returns thereupon, in such enterprises as educational and hygienic work, municipal construction, and experimental work for the improvement of agricultural products and live-stock. It is no exaggeration to say that the Company has rendered a tremendous contribution to the cultural and economic development of Manchuria. The history of the S.M.R. is the history of Japan in Manchuria. Particularly, since the birth of the new State of Manchoukuo, this huge organization that controls the bulk of Japan's economic interests in Manchuria, has placed its resources, excellent personal experience and knowledge behind the numerous projects which Manchoukuo has initiated in an effort to develop itself into an orderly, modern and prosperous state.

Mr. Yosuke Matsuoka, President of the South Manchuria Railway Company

The South Manchuria Railway Company is primarily a railway concern, but its far-flung and all-embracing pioneer activities have won for it the title of the "bearer of the light of civilization into Manchuria." As a railway concern it occupies a pre-eminent position in Eastern Asia, and the whole of Asia for that matter. Its railway and smooth punctual trains not only furnish the backbone of the transportation system in Central and South Manchuria, but also constitute an indispensable link in the international railway communication between the Far East and Europe via Siberia.

Measuring 700 miles, the railway lines owned by the S.M.R. consist of the trunk line linking the port of Dairen with the capital city of Hsinking, the Mukden-Antung line, and the branches attached to the former which connect with Fushun, the site of the world-famous open-cut mine, Yingkou and Port Arthur. An epochal step paving the way for the enforcement of a system of unified and rational management of all railways in the new State was taken by the Manchoukuo Government on February 9, 1933, when she entrusted to the S.M.R. the management of the entire State railways totalling 1,820 miles, and the construction of a network of 3,000 miles of new lines under its ten-year program of railway construction. Since then the Railway Company has built for

Manchoukuo about 1,700 miles of new railroads, the management of which has also been entrusted to the S.M.R. In addition, 600 miles of lines have been partially completed. Like branches of a tree, they extend northward to the Amur, northeastward to the Ussuri, westward to the sacred hot-springs of Mongolia and southward to Chengteh in Jehol. The vast network of railways under S.M.R. administration suddenly swelled by 1,080 miles in March, 1935, when the operation and management of the North Manchuria Railway was commissioned to the S.M.R. upon its transfer to Manchoukuo by the Soviet Union. Furthermore, at the request of the Government-General of Chosen, the Company in October, 1933, took over the management of the North Chosen Railways, 200 miles in length, for the purpose of facilitating the through-traffic between Hsinking and North Korea. Thus, to-day, the South Manchuria Railway Company has under its direct management all the railways in Manchuria and North Korea, having a total length of 6,100 miles. It is needless to say that this pioneer railway company has, during the past few years, effected numerous improvements on all the hitherto obsolete State railways in order to transform them into an efficient railway system provided with up-to-date equipment and facilities.

Like all other large railway corporations, such as the Canadian Pacific Railway, the S.M.R. owns and operates fifteen modern hotels in the larger cities in Manchuria. The enterprises affiliated with these hotels are the dining-car service, laundry plants, motor-car service and the commissioned operation of hotels.

In connection with the railways, a word is necessary of the railway workshops owned and operated by the S.M.R. When the Company took over the railway system some thirty years ago, there was no railway workshop in Manchuria and the Company had to order all rolling-stock and other railway equipment from Japan. To-day, it has five railway workshops in Dairen, Mukden, Hsinking, Harbin and Tsitsihar. The largest of these is the Dairen Workshop wherein 5,400 employees are engaged in the manufacture of stream-lined trains for the S.M.R. and the other types of trains for other railway concerns.

Simultaneously with the program of railway construction, extensive plans for the building of highways for motor traffic have been formulated since the birth of the new State, and the work advanced with remarkable rapidity. The bus lines which possess potentialities to compete with the railways or those which act as the chief instrument of transportation in the localities through which they traverse, have been nationalized and together with the State Railways, have been entrusted to the S.M.R. The management of 3,200 miles of such bus lines has already been commissioned to the S.M.R., while more are expected to be entrusted to this organization in the future.

It is an undisputed fact that the seaports and waterways occupy an important position in connection with railway transportation. The S.M.R. Company has, therefore, been improving and operating from the outset the harbors and wharves at the ports of Dairen, Antung and Yingkou. In addition to these three ports, the S.M.R. has been entrusted with the management and operation of the three North Chosen seaports of Seishin, Yuki and Rashin. The harbor construction program of Rashin is still under way although the port has been opened for shipping after the completion of the first-stage project. In the port of Hulutao, harbor construction is being pushed forward by the Company in its endeavor to furnish another outlet for Manchurian products to the Gulf of Pechili. In view of the necessity of establishing a close connection between the railways, waterways and harbors, the water transportation enterprises on Sungari, Amur and the Liao rivers have also been entrusted to the S.M.R. The total length of waterways under the control of the organization is more than 3,300 miles.

From the point of view of both investments and profits of the enterprises under the direct control of the South Manchuria Railway Company, mining occupies a position next to railways. Among the mining enterprises, coal mining monopolizes the central position. At the end of the first half of fiscal year 1936, the total deposits in the Fushun and Yentai Mines were estimated at 970,000,000 tons. Up till the present, the Company has invested almost Y.120,000,000 in this enterprise. The scale of the open-cut mines at Kuchengtzu is reputed to be the world's greatest; its magnitude may well be surmized from the fact that the amount of dirt excavated up till the present is equivalent to that when the Panama Canal was constructed. Extending over an area of 60,165,000 square meters, the Fushun Collieries have an estimated coal deposit of 950,000,000 tons.

When the Company commenced the exploitation of the Fushun coal field in 1907, there dawned a new era of large-scale mining based upon scientific methods. Careful survey and systematic development were to be the future object of the authorities concerned. As the first step, the Company improved three of the pits which existed then, at enormous expenditure. In addition to the large open-cut mines which rank with the world's greatest both in scale and output, several new pits have since then been opened, wherein the sand-flushing method has been introduced. As the result of the advancement of this ambitious program, the daily output of these mines has risen to the astonishing figure of 25,000 tons.

With the growing contribution of the collieries to the economic world and with the increase of the population of Fushun, the Company was led to construct and manage a modern town with electric light, gas, tramways, water supply, telephone and other modern facilities. In order to utilize profitably the motive power obtainable from the copious supply of coal, the S.M.R. took under its wings several subsidiary enterprises such as the electric power house, ammonium sulphate plant, coke factory, and the shale oil plant.

In the days of the Changs when misrule and disorder prevailed, it was necessary for the Japanese Government to authorize the S.M.R. Company to carry out civil, educational, hygienic, industrial and social works within the Railway Zone which was ceded to Japan. The task has been ably fulfilled ever since and due credit ought to be given to the S.M.R. for its systematic activities in forming within the Railway Zone the center of Manchoukuo economics. The expenses necessary for local administration are shouldered by the Company and only a fractional part of the sum essential for maintenance and repairs of the various facilities are collected from the inhabitants of the Railway Zone. The rapid increase in population since the establishment of Manchoukuo, the development of the various enterprises and the progress in the economic construction have brought about a phenomenal change in the towns and cities within the Railway Zone.

Furthermore, with due respect to the independence of Manchoukuo and in striving to aid the healthy growth of the youthful Empire, Japan has already established the fundamental principles for the transfer of administrative rights following the abolition of extraterritoriality which she enjoyed in Manchuria. In connection with this, the South Manchuria Railway Company has decided to reserve only those things which are inseparable parts of its enterprises and transfer all the local facilities and establishments to the Government of Manchoukuo.

Within the Railway Zone, the S.M.R. has been bending its efforts towards the establishment and the maintenance of educational, hygienic, and civil engineering facilities. To this day, more than Y.193,000,000 have been invested therein as enterprise fees. Furthermore, the annual expenditures for their upkeep amount to approximately Y.21,000,000, registering a deficit of Y.12,000,000. By this, it is possible to perceive that the mission of the South Manchuria Railway Company is not limited to the railway and mining enterprises.

Of all the activities of the S.M.R. in the Railway Zone, the administration of education and cultural facilities is the most noteworthy. The educational institutions established and managed for the benefit and welfare of Japanese, Manchoukuoans and Chosenese are as follows:—

37 Kindergartens	56 Vocational Schools
167 Primary Schools	1 Normal College
7 Middle Schools	1 Technical College
7 Girls' High Schools	1 Medical University

In order to furnish these educational institutions with adequate reference books, the S.M.R. has taken the initiative in establishing and maintaining libraries in almost all the important towns. To-day, there exist 30 libraries having an aggregate of 611,000 volumes, besides 495 circulating libraries with some 42,000 volumes for circulation throughout Manchuria.

Next in importance to the educational institutions is the health and sanitation enterprises of the Company. Ever since the commencement of its activities, the S.M.R. has been taking an extremely active part in bringing about the observation and enforcement of the ordinary sanitation measures among a primitive population, and also in keeping a constant vigil over the possible outbreak of dreaded and deadly epidemics. In strict adherence to this principle, the Company has been playing an important rôle in carrying on free vaccination and various inoculations against epidemics whenever necessity arose. The systematic and scientific analysis of drinking water in the various localities is also a great factor in the prevention

of diseases. In the humanitarian enterprises of the elimination of epidemic diseases such as bubonic plague, the Company has spared no efforts and has even suffered the sacrifice of the lives of its countless research workers. Sensing the necessity of adequate hygienic facilities, the S.M.R. has undertaken to maintain 32 well equipped hospitals and 17 clinics besides dispatching 29 physicians to the various points where railways have been constructed.

Reputed to be the Orient's best both in equipment and staff, the Dairen Hospital, which was constructed and equipped by the Company at the cost of eight million yen, is the crowning monument to this social enterprise. It has now become an independent organization under the Company's general supervision. In order to make the hygienic facilities thorough, the Company has taken upon its shoulders the maintenance of bacteriological examination stations in six towns. Trained nurses are stationed in sixteen localities where no medical facilities are to be found and these are dispatched upon regular visitation routes.

The largest and the most outstanding of these hygienic facilities is the Hygienic Institute, which has been founded for researches in the maintenance of health and the manufacture of various sera and vaccines for the prevention of diseases peculiar to Manchuria. The authorities concerned have been especially active and energetic in finding preventive measures, and already the bubonic plague which long existed in Manchuria has been almost completely conquered. The dreaded typhus and dysentery, too, have practically been controlled and what is more, energies are bent towards the extermination of contagious diseases among the live-stock.

Just as it conducts its administrative activities within the Railway Zone in addition to the operation of railways and coal mines, the S.M.R. has assumed the task of encouraging research work and fostering the development of various industries throughout Manchuria. This, the Company has been doing ever since its establishment in 1907. As has been mentioned in the preceding paragraph, research workers of the S.M.R. have made great contribution to medical science and humanity. In the realms of economics and politics, too, the Company's research and investigation organs have not only won a splendid reputation but have also been instrumental in improving the Manchurian staple products, in discovering mineral resources, in founding new enterprises and industries, and in establishing a stable currency system. As a result of the recent reorganization, the former Economic Research Committee became a part of the newly created Industry Bureau.

To this Bureau is allotted the task of planning and guiding the pioneering activities for the Company. The Commerce and Industry, Agriculture and Forestry, Mining, and the Transportation Departments, the Archives and Library, the Research Board, the Geological Institute, the Manchurian Resources Museum, the Veterinary Institute, and the Agricultural Stations with their seed and sapling farms are now parts of the Industry Bureau and are given tasks most suited for the trained staff. A total of 1,250 competent employees are engaged in this Bureau whose annual expenditures amount to eight million yen.

For the fostering and encouragement of industries there is the Central Laboratory where most of the chemical and physical researches of the Company are being carried on. Although this scientific institution is not officially under the direct control of the Industry Bureau, it is nevertheless under the general supervision of the Bureau. In the Central Laboratory alone, the S.M.R. spends more than one million yen in the course of a year.

In addition to the above-mentioned activities, the Company has close connections with private enterprises. In order to encourage them it not only advances funds at a low rate of interest but also furnish them with subsidies amounting to more than two million yen annually.

As one of the primary missions of the South Manchuria Railway Company is to foster various enterprises as an intermediate step in its development of Manchuria, it has taken the initiative in numerous public works and basic enterprises even where large deficits were foreseen, but remuneration cannot be expected at first. Among the enterprises are electric power plants, gas works, marine transportation and docking, express and warehousing, electric tramway and bus services, iron and steel works, glass factories, besides activities in mining. It is a noteworthy fact that the Company launched upon these enterprises when they were not paying propositions; but when through sagacious policies they became economically sound and firm, the S. M. R. transformed them one by one into independent corporations. The Company has made investments into all the basic industries, such as, aviation, telephone and telegraph, banking, automobile, mining, agriculture, cement manufacture and chemical industries. At present, 80 affiliated or subsidiary corporations and concerns exist with total investment exceeding 700 million yen, 49 per cent of which or 345 million yen represent the S.M.R.'s share of the capital.

From what has been described in the foregoing paragraphs, the reader will readily understand the significance of the South Manchuria Railway Company—its important special mission and its all-embracing and far-flung activities. And now I wish to proceed to delve into its financial status before concluding this article.

When the Company was established in 1907, its authorized capital was 200 million yen, of which the equivalent of 100 million yen was furnished by the Japanese Government by turning over to the Company all its properties in railways and coal mines and their appurtenances. The other half was offered for subscription to the Chinese Government and the Japanese and Chinese public. The Chinese, both Government and public, however, flatly declined the friendly offer, while the Japanese public oversubscribed the offer more than 1,077 times. With the phenomenal growth of its activities and the increase in affiliated enterprises, the Company increased its capital to 440 million yen in 1920. The flourishing condition of the Company continued, and in 1933 the capital was increased to 800 million yen, with the Government shouldering one-half and the general public the other half.

Besides this tremendous outlay of capital, the Company has issued debentures to the amount of 778 million yen. The appraisal of the S.M.R.'s property at two billion yen is a very conservative estimate indeed. With regard to capital, great corporations comparable to this Company are found in the world. In all probability, the United States Steel Corporation is the greatest in this respect, but in the extent of its activities, in the magnitude of its mission, and its meritorious achievements during the past thirty years, the South Manchuria Railway Company may well be confident that it surpasses all other corporations in the world. With 170 thousand employees it has directly or indirectly a profound concern for the destiny of all the races in Eastern Asia. This Company is by no means a mere profit-making concern—the fundamental principle of the concern is to carry on, even with great deficits, various large-scale activities for the welfare of the people and the development of all branches of culture in Manchuria. In other words, the Company has been the carrier of the light of civilization into Manchuria. With relentless energy and unsparing efforts the Mantetsu family continues its great humanitarian activities. Herein lies the delight, pride and glory of the South Manchuria Railway Company.

British Firm Gets Huge Contract

All-British engineering equipment, the contract to exceed $2,500,000, will be supplied to the Chuchow Central Locomotive and Rolling Stock Repair Shop, according to an agreement reached between the Ministry of Railways and Messrs. Inniss & Riddle (China), Ltd. This repair shop is being constructed to undertake maintenance and repairs for the equipment of various government railways in China.

The equipment called for includes a large number of Alfred Herbert and other machine tools, hydraulic machinery, welding plants, W. Canning & Co. chromium plating plant, foundry equipment comprising cupolas, crucibles, moulding machines, etc., oil fired and electric furnaces, electro-pneumatic forging presses and hammers, spring making machines, testing equipment, air compressors, pneumatic tools, complete set of woodworking machines, Morris electric overhead travelling cranes, electric hoists, weighing bridges, electric motors and control gear, transformers, switchgear, cables, water supply and pumping plant, structural steel, etc.

Not far from Chuchow, near Pinghsiang, Messrs. Inniss & Riddle are now starting the erection of a complete electric power station including B.T.H. turbo-alternator, switchgear and transformers, Mirrlees Diesel plant, Callender cables, Babcock and Wilcox boilers, Morris crane, etc. Recently, they have also secured a contract for a 2,500 kw. P.T.H. turbo-generator, switchgear, etc., for Sianfu and a repeat order for the Chenchow power station of the Lunghai Railway for two B.T.H./Belliss & Morcom generating sets and B. & W. boiler plant, orders for a 50 ton Morris electric crane for Hongkong, and a 25 ton crane for Taiyuanfu.

Mr. A. J. Percival, managing director of Messrs. Inniss & Riddle (China), Ltd., left for London via Siberia at the end of April to supervise the Chuchow contract arrangements in London.

German-Manchoukuo Trade Pact

GERMANY is rapidly regaining the trade and economic supremacy in China, Japan and the Far East, which she lost during the World War, according to a survey by the American Institute of Pacific Relations. By adroitly dropping the mailed-fist tactics that she employed before the war and inaugurating an era of skilful and friendly negotiation, the survey finds that Nazi Germany is re-establishing her trade relations in the Far East and entrenching herself there economically on a sound and probably permanent basis.

The two countries most calculated to suffer from Nazi Germany's new policy in China and Japan, according to the survey, are the United States and Great Britain. There is every indication that Germany will succeed in wresting away a sizeable portion of British and American trade in the Orient. The theory that Germany is the natural political friend and economic ally of the nations in Asia, which are rising to industrial independence, is being developed and applied to the extreme degree by Berlin.

The progress of Germany in recapturing her markets in the East is regarded all the more significant since, while Germany's investments extend to long term credits, licenses and limited participation in profits and managements, yet they have in no case gone so far as American investments of the type of Ford and General Motors whose factories, entirely owned by foreign companies, have engaged in production on foreign soil. The Third Reich has now become more and more careful to avoid giving offence to the national feelings of the various countries concerned.

The Institute finds that America's tendency toward economic imperialism, especially in the Far East, appears to be on the wane, but with Germany quick and ready to take her place. Germany has developed a more subtle method of participation in the economic development of the Far East and the re-establishment of her former position. This consists of joint enterprises in which German capital participates together with that of Japan, Manchoukuo, China and the Dutch East Indies. In such enterprises, the German side supplies the machinery patents and technical management, which she is particularly capable of furnishing, while the Far Eastern countries where these enterprises are undertaken furnish the land, money and labor.

The German side of the companies generally hold 51 per cent or more of the stock, which, while giving them the controlling interest, nevertheless permits of the gradual industrialization and economic development of those countries. It may be said that no other country has ever given, either willingly or unwillingly, the national trades of other countries with which they are dealing, such a great share in the profits of the trade, and it must be emphasized that under this system Germany's lack of capital, does not prevent her from fostering the growth of a national trade organization in the Far Eastern countries.

The extent to which this new trading mechanism has succeeded for Nazi Germany is demonstrated by the fact, that Germany's exports to China, Hongkong and Manchoukuo have increased—according to the figures of the institute—from 37,900,000 Reich Marks during the first half of 1934 to 65,000,000 Reich Marks in the corresponding period of 1936. During 1936, it is ascertained, China imported $150,200,000 worth of goods from Germany as against $103,400,000 in 1934. Germany's share of China's total imports rose in the same period from 11.18 per cent to 15.91 per cent. The success of the new German economic strategy in the Far East is at the expense largely of Great Britain and the United States, and it should be realized by the former that this is due to the fact, which should be emphasized again and again, that Germany is aiding the Far Eastern countries, in their industrialization and is assisting them to rise to economic and industrial independence, instead of merely trying to sell them goods, and especially textiles.

Germany is playing an especial rôle in the industrialization of Manchoukuo as the result of a three-cornered trade agreement negotiated with Manchoukuo and Japan last year. Under this agreement Germany balances her exports and imports with Japan on a basis of one to four and then re-establishes her trade balance by a ratio of four to one with Manchoukuo. This pact was concluded on June 1, 1936, and terminating at the end of May, this year, served for experimental purposes as the basis of all trade operations between Germany and Manchoukuo. What the first year's experience taught as to the real workings of the agreement may be illuminative on how each side stands at present, though it is pertinent to make a survey of recent Manchoukuo-German trade relations in order to determine the effect of the agreement.

According to the pact, Germany admitted the importation of Manchurian products during the period of one year to the value of 100 million yuan, calculated on the basis of c.i.f. prices, whereas Manchoukuo undertook to purchase 25 million yuan worth of German goods during the same period. Regarding payment, Germany agreed to pay in foreign exchange bills three-quarter of the total value of goods purchased by her, the remaining quarter being payable in Reich Marks to be deposited with a bank designated by the Manchoukuo authorities against payment for the German exports to this country.

In other words, under this agreement the Third Reich should import 100 million worth of Manchurian soya beans on an experimental basis during the year, which represent an absolute German need covering material for oil and cattle feed; and on the other hand to pay a fourth of the total value thereof in commodities manufactured in her own country, to save the settlement of her foreign exchange accounts which of late are on the decrease. This system has had some salutary effect on Germany's export trade, as the Manchurian market was opened to German commodities to the extent of 25 million yuan. Glancing over the Germano-Manchoukuo trade statistics in recent years will give a better view of the present situation.

The total value of the trade between the two countries in 1932, was returned at 74,073,000 yuan. The figure fell to 66,395,000 yuan in 1933 and further to 53,311,000 in 1934, and to 32,799,000 in 1935. The figure for 1935, it may be noticed, declined to 44 per cent of that for 1932. Turning to soya bean exports from Manchoukuo to Germany, the latter purchased 59,653,000 yuan worth of this farm product in 1932, the figure dwindling to only 22,188,000 or 37 per cent in 1935. Quite the contrary happened with German exports to Manchoukuo. The German goods, consisting chiefly of metals, chemical substances, textiles, etc., to the value of 6,511,000 yuan in 1932. The following year witnessed a considerable rise in the amount which was returned at 10,577,000 yuan. The figure steadily rose from 12,508,000 yuan in 1934 further to 14,742,000 yuan in 1935. This upward tendency of Germany's export trade with Manchoukuo during this period, while forming a striking contrast to the downward trend of her imports, eloquently reported the fact that various great constructive enterprises were in full swing in the new-born Far Eastern State, laying the foundation for a sound base on which to co-operate and gain a supreme place among the industrial countries in the Far East.

And yet, it should be noted that the steady increase in business and industrialization, the import returns for 1935 still left quite a broad margin from the maximum named in the 1936 agreement, namely, to purchase 25 million yuan worth of German goods in conformity with the pact. Particular note also should be taken of the decline in Manchurian exports to Germany during this period, which is attributable to the unfavorable tendency of Germany's foreign trade as a whole during several years past. The total value of her foreign trade in 1929 was 26,930 million Reich Marks, comprising 13,480 million marks representing exports and 13,450 million marks for imports. In the course of the following six years the figure sharply declined to 8,430 million marks, or less than a third. The amounts of German exports and imports during the course of these six years are given below (in million marks) :—

	Exports	*Imports*	*Total*
1929	13,480	13,450	26,930
1931	9,600	6,700	16,300
1933	4,870	4,200	9,070
1935	4,270	4,160	8,430

The total for 1935, as the above table indicates, gradually shrank to 31 per cent of that for 1929. Doubtless, this decrease in her foreign trade was not a welcome phenomenon for Nazi Germany, and still greater anxiety was caused by the tremendous reduction in export excess. Germany's trade accounts used to be

balanced by a considerable surplus annually, but the conclusion of the first fiscal year under Nazi rule resulted in a deficit of 280 million marks (1934). In 1930, 1,650 million marks were recorded on the right side of the ledger, which sum increased to 2,870 million marks. Although the surplus fell to 1,700 million marks in 1932 and further to 670 million marks in 1933, the accounts still balanced favorably. This tendency abruptly stopped in 1934 and German imports exceeded exports by 280 million marks in value. To meet the emergency the German Government established the Commodity Control Bureau in July of the same year, intending to enforce a systematic control over all imports, according to kinds of merchandise and countries of origin.

This action proved effective. In the ensuing year the Third Reich again was able to balance her foreign trade accounts favorably, and a surplus of slightly more than 110 million marks was achieved. But still German foreign trade faced a crisis—prior to the cheering turn taken by the trade tide only recently—the specie of the Berlin Reichsbank touched bottom, as may be observed to some extent by the following statistics of the Hamburg branch of the Yokohama Specie Bank, showing the specie reserve at home as well as foreign currencies held abroad by the Reichsbank from 1929 to 1936 (in units of a million marks) :—

	Specie Reserve	*Foreign Currencies*
1929 (end of January)	2,283	404
1930 ,, ...	2,216	469
1931 ,, ...	984	172
1932 ,, ...	806	115
1933 ,, ...	386	9
1934 ,, ...	79	5
1935 ,, ...	82	5
1936 (end of June)	72	5
1936 (on Sept. 15.)	66	6

The above table gives a vivid description of how M.2,300,000,000 in gold specie, held at the end of January, 1929, became drained off to only M.72,000,000 by the end of June, 1936, the month the Germano-Manchoukuo agreement was put into operation. Under such circumstances, Germany was driven to improve her export trade, while imposing rigorous restrictions on imports. Again this has more or less affected the trade treaty text in question.

According to the "Monthly Statistics of Foreign Trade of Manchoukuo" Germany purchased from January to May, 1935, 274,738 tons of Manchurian soya beans and 247,643 tons during the corresponding period of last year. From June to October, 1935, 140,054 tons were bought by that country, but from June to October, the same year, the agreement was enforced, the volume rose to 219,146 tons. On the other hand Manchoukuo imported from January to May, 1935, 7,121,837 yuan (Manchoukuo currency) in German commodities and 6,631,848 yuan during the corresponding term of 1936. The figure of German commodities bought by Manchoukuo from June to October, 1935, was 5,796,942 yuan and decreased to 4,404,893 yuan during the same period in 1936.

Considering the above figures it must be realized that Germany made greater sacrifices than Manchoukuo, so long as the period of five months after the agreement was enforced is concerned, the German side gaining nothing at all from the pact. As might have been expected, the practical good of the trading pact was seriously challenged by the German authorities when the extension of the agreement was considered, following its expiration in May, this year.

At a meeting of the Manchoukuo Committee on the renewal of the Germano-Manchoukuo agreement at Hsinking early this February, it was reported that the total bean stocks Germany imported during the term of the pact was estimated at something above 80 million yuan, which sum, compared with the corresponding figure of the previous year might be regarded as a fair improvement. On the other hand Manchoukuo's imports of German goods registered a substantial falling-off, the total estimate for the year's term amounting to 15 million yuan. A deficit of five million yuan was the result, considering that Manchoukuo was bound by the pact to buy one-quarter of the total or M.Y.20,000,000 worth of German goods.

At the preliminaries to the elaboration of the text in 1936, the German side designated M.Y.30,000,000 for Manchoukuo's import of German goods. This proposal was met by a counter-proposition of M.Y.15,000,000. Finally a compromise of 25 million yuan was arrived at. As already stated, the deficit for which the Manchoukuo side was called upon to account being M.Y.5,000,000. How to deal with this estimated deficit was of paramount importance for the renewal of the trade pact, when Mr. Hiyoshi Kato, Manchoukuo Commercial Representative in the Reich capital conferred with Mr. H. C. H. Wohltat of the German Administration of Foreign Affairs. That a mutual satisfactory solution was found is evidenced by the fact that the present agreement is to remain in force until May 31, 1940, after which date negotiations may be held for a third renewal of the pact.

A new clause, and seemingly the most important point added to the already existing text of the accord, is that both contracting parties have agreed to negotiate for any revision of the agreement in case either party communicates its desire for such revision on and after January 1, 1938. This point might become of paramount importance, and it is expected, that it will be quite handy for the German authorities, in case the mentioned deficit problem should prove unsoluble. As facts about the settlement of this point have not been disclosed, it may be assumed that, in accordance with the original agreement, the deficit amount has been carried forward to the succeeding year. There remains, however, some doubt as to the liability of the problem to be solved that way, as the prospect for the next few years is by no means reassuring of Manchoukuo's ability to buy German goods to the amount of one-quarter of her exports to Germany.

Unconfirmed reports state that Manchoukuo expects to purchase between 15 and 16 million yuan worth of German goods annually for several years to come without encountering much difficulty. The expected purchases by the South Manchuria Railway Company and other corporations affiliated thereto playing a decisive rôle in the issue. These estimates were actually put down in concrete figures at M.Y.6,160,000 in 1937, M.Y.5,600,000 in 1938, and M.Y.5,000,000 in 1939. The other general imports were placed at M.Y.10,000,000 for each of the next four years, making a grand total of M.Y.15,000,000 to M.Y.16,000,000 annually. This sounds entirely reasonable, if—and this is the deciding point—Germany could be satisfied annually with 60 million yuan worth of Manchurian soya beans and other produce, which is very unlikely as the past has proved.

Details of the German-Manchoukuo trade agreement, even its scope and nature of its stipulations, have so far not been disclosed, and as a result there have been many conjectures among trading interests and foreign Governments. If details are being withheld from publication due to political considerations, it is only to be expected that they never will be published.

The agreement is a sort of trade convention between the Foreign Exchange Control Bureau of the German Government and the corresponding institution of the Manchoukuo Government. It is not a treaty between the two Governments as such, but it may be regarded, nevertheless, as a trade treaty in its practical effect. Intended to readjust the trade balances of Germany with Japan, it does not implicate an obligation on Japan's part to guarantee for Manchoukuo's deficit, which she might be called upon to do, with, however, little likelihood in the immediate future.

To the casual observer this problem might appear to be a difficult one to tackle. It all remains to be seen, but as an offical statement regarding this problem is still to be expected, it is premature to make any predictions. There is, however, no doubt about the fact that the rejuvenation of Germany coinciding happily with the establishment of the new State of Manchoukuo has borne fruit to the mutual satisfaction of the two countries, and furthermore that the able representation of Germany by Dr. Karl Knoll in Manchoukuo, as well as that of Mr. Hiyoshi Kato of the new Eastern Empire in Berlin, will overcome all obstacles. This is evidenced by the preparations of both nations to bargain and to sacrifice certain interests for the attainment of a strong bond which is to fasten the mutual good relationship in spite of a half globe rotation separating the two countries.

Shimonoseki Tunnel Scheme

Japan's greatest engineering project, the Kwanmon Straits tunnel, linking Moji with Shimonoseki was revived recently by the Ministry of Railways. The scheme was shelved last year by economy-bent Parliamentarians. The Ministry has drafted a new four-year plan for the construction of the tunnel at the cost of Y.18,000.000, and will present it, together with another estimate of Y.2,500,000 for initial expenses, to the extraordinary session of the Diet in the near future.

Railway Construction in China's South-West

French Yunnan Railway May Lose Some Significance

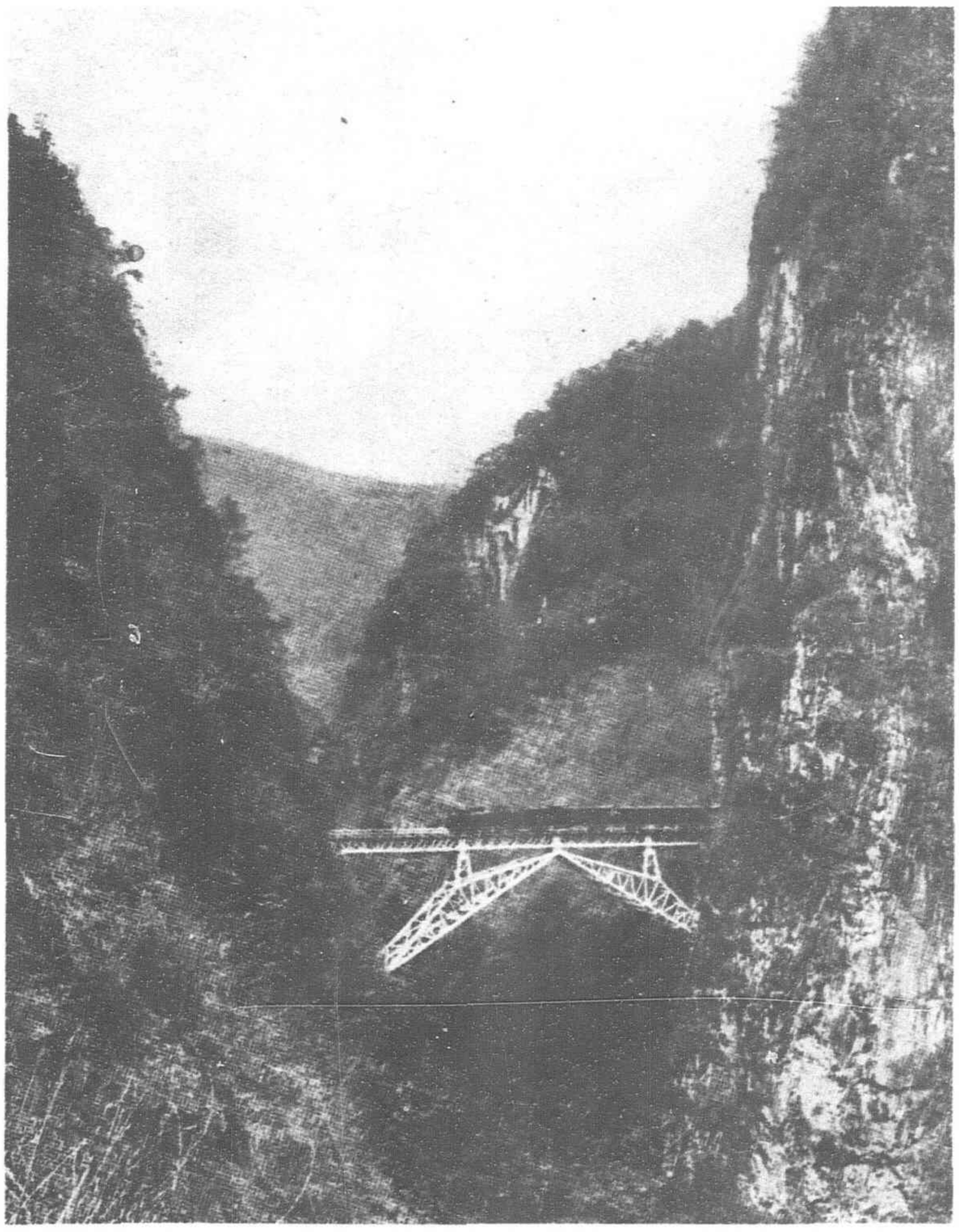
THE Yunnan Railway, constructed by French interests, may lose some part of its significance as a communication link to the remote province of Yunnan following the completion of the contemplated Kweichow-Kunming line. Prior to the construction of the Nanking-Yunnan highway, through traffic on which was successfully established by the recent Nanking-Yunnan bus expedition, it may be recalled that the Yunnan railway, connecting Indo-China ports with this far-flung southern Chinese province, was the sole route of approach to Kunming and the various districts of the southwestern frontier. Chinese travellers who wanted to journey in Yunnan had first to sail for Haiphong, Indo-China, whence they proceeded to their destination via the French railway.

Since the completion of the highway, much passenger and freight traffic of the railway has been diverted, as Chinese travellers do not like to undergo all the procedure involved in travelling through a foreign country, especially when they want to get to one of their own provinces. Survey work of the projected Kweichow-Yunnan line has almost been concluded, and it is understood that this line will much facilitate communication in the south-west of China inasmuch as it is intended to link the line at Kweiyang with another important planned line, the Hunan-Kweichow Railway, ultimately minimizing the importance of the French line.

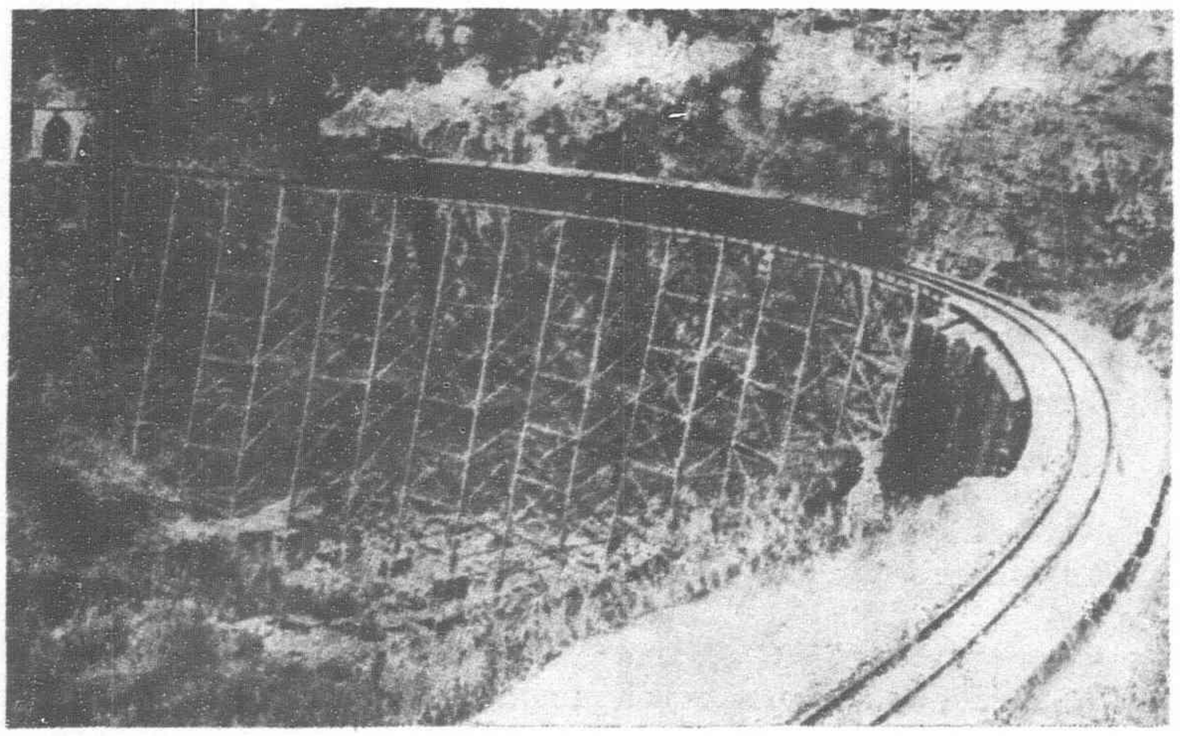
The French Yunnan Railway, a description of which was given in an informative article, appearing in *The Far Eastern Review* for December, 1936, runs as far as 464 kilometers into Chinese territory. Work was begun in 1901 and the Haiphong-Kunming span of the line was completed in the beginning of 1910. The capital invested amounted to 19,250,000 francs. From the engineer's point of view, the line is a remarkable feat, hardly excelled by any other railway in the Far East. Work on this line was carried out under extremely difficult conditions. Passing through thick tropical jungle, thousands of workers died from Malaria; others fell victim to snake-bites and attacks by tigers or other wild animals. Every rail represents struggle and victory against Nature.

Leaving Laokay, a French station in the tropical jungle, 230 feet above sea level, on the Chinese frontier, the railway, ascending gradual slopes, passes along the wild torrents of the Nam Ti, the Pa Ta Ho, the Ta Chan Ho, sometimes hugging them and sometimes climbing to as much as 1,000 feet above them, crossing them on wonderfully light dauntless bridges, clutching at gigantic precipices. Thus passing over some 107 viaducts and bridges of not less than 65 feet span, and through some 172 tunnels, whose combined length represents more than 15 miles, the line follows the banks of the Tang Tche lake, and at approximately 6,600 feet above sea level reaches the magnificent plateau of Kunming, with its abundance of corn, rice, and fruit trees.

There is no hope of linking the Yunnan Railway with the future Kweichow-Kunming line, because the former has a meter gauge while the latter will have the standard gauge of Chinese railways of four feet and eight-and-a-half inch. While the French line is expected soon to lose part of its commercial value, there is, however, no doubt that it will retain its strategic importance for the Chinese authorities, who doubtless will attempt to come to some sort of agreement with the French Railway Company, as will be necessary to maintain the French line.



A cantilever bridge on the frontier district of the Indo-China-Yunnan Railway



The lace bridge of trunk line of the French Yunnan Railway

Gorges of the Po-Ta-Ho on the Chinese side of the Haiphong-Kunming Trunk Line

The Chien Tang River Bridge

By T. E. MAO, Dr. ENG., Engineering Director, in The Quarterly Review of Chinese Railways

(According to ancient Chinese legend the dieties of the Chien Tang River, in Chekiang, became angered at man and as a punishment decreed that the Chien Tang River might never be spanned by the hand of man. Superstitious Chinese attributed a number of accidents that occurred when the Chien Tang River bridge was in course of erection to this ancient curse. Its power evidently has now lapsed, however, for the great structure now spans the stream and all the work of building it is nearly completed. While the work involved several contracts the major portion of the building of the structure was carried out by the well-known Danish engineering firm of Messrs. A. Corrit of Shanghai. This Danish firm built the fifteen main piers for the structure and, as sub-contractors for Messrs. Dorman Long, assembled and erected the steel work of the main spans).

(Continued from May, 1937)

Steel Used for Superstructure of Bridge

THE internal stresses produced by the external loading in ordinary bridge truss members are chiefly axial tension, axial compression, bending and shearing stresses. Steel is generally regarded as the most suitable material in truss construction. Various species of steel are manufactured for use, but chromador steel proves much more effective than ordinary carbon steel. A comparison of the two is given below :

(*a*) Axial Tensile Stress

The allowable axial tensile stress may be determined by investigating the ultimate tensile stress and the yielding point. The higher the ultimate stress, the greater the factor of safety ; the higher the yielding point, the less will be the deformation.

(*b*) Axial Compressive Stress

It is not only the quality of the steel used that affects the allowable compressive stress but the length and the cross-section of the member. The ratio of the length to its least radius of gyration, say L/r, plays important part in determining the compressive stress.

(*c*) Bending Stress

The allowable bending stress of steel may be determined by testing steel beams.

(*d*) Shearing Stress

The rivets connecting the joint are all subjected to shearing stress. They should be designed to develop sufficient resistance against the existing shear.

From the above tables, chromador steel proves much more effective, thus, after repeated experiments, it was decided to adopt the chromador steel as the main construction material for the superstructures of the bridge.

As to the total cost of the superstructure construction, it was divided into five divisions ; the percentages of their respective cost are given in the following :

1. Cost of design, 5%
2. Cost of materials, 50%
3. Cost for manufacturing, 20%
4. Cost for transportation, 10%
5. Cost for erection and fitting-up, 15%

Economically speaking, the cost of chromador steel is higher than that of the ordinary carbon steel. Although the net section

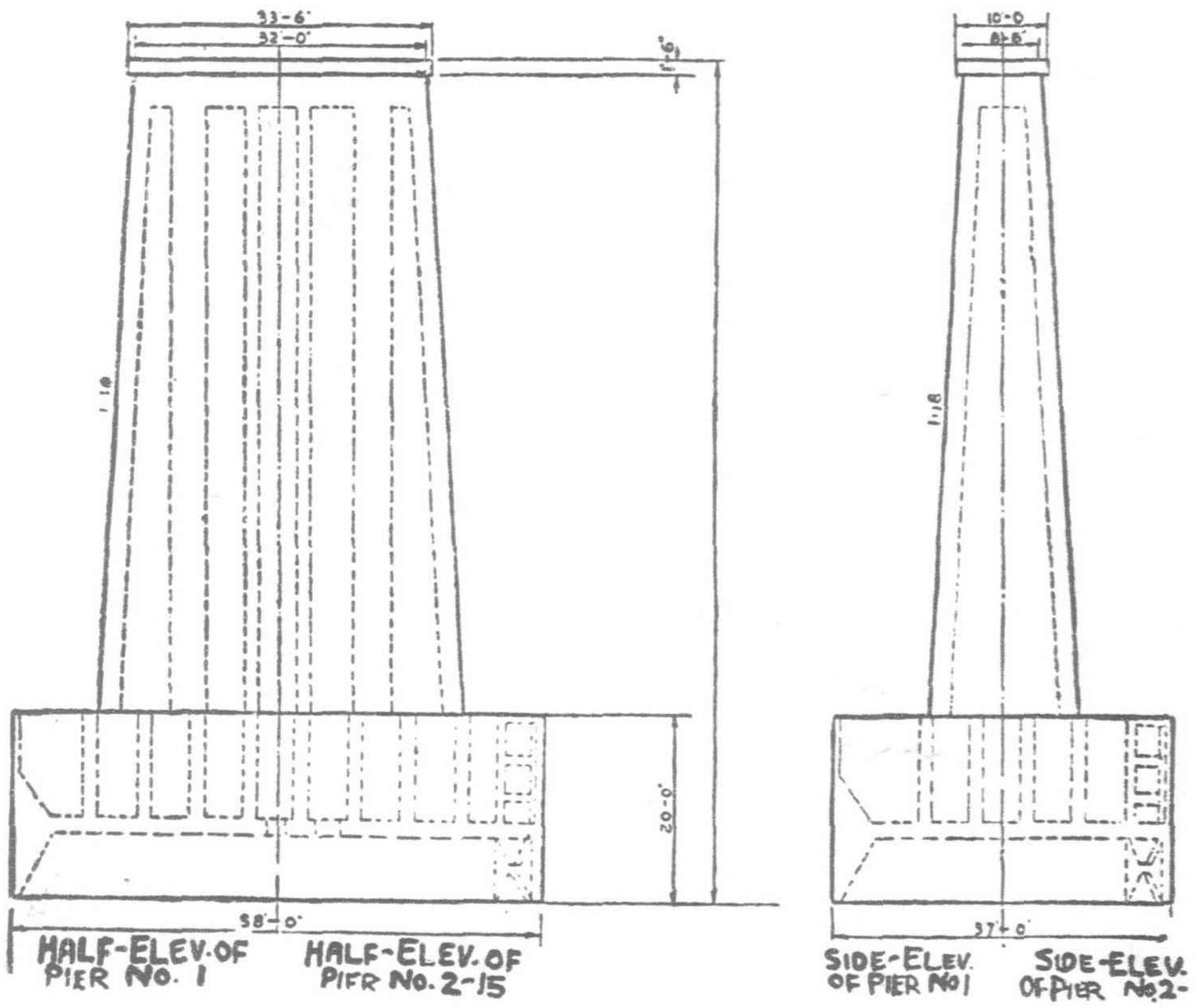


Fig. 5.—The same process as for piers No. 1 to 6 repeated for No. 7 to 15, except here was the dam to be the top of the piles instead of rock stratum

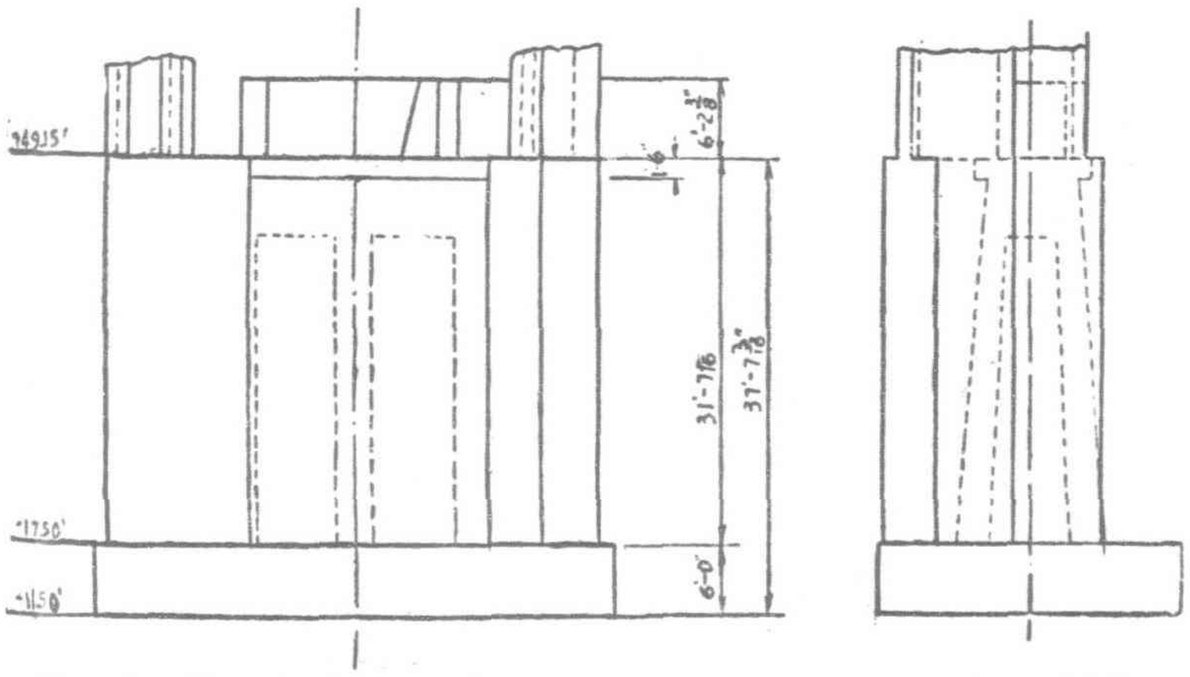


Fig. 2.—Sketch, illustrating the excavation process, by which the six piers of the north approach were to be constructed

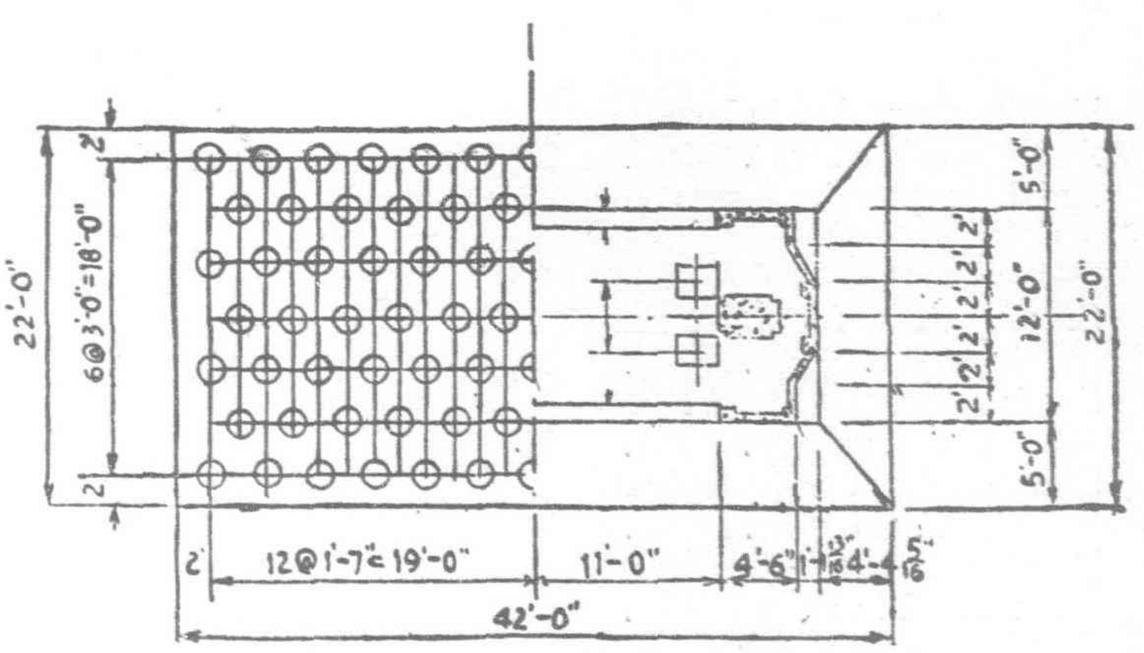


Fig. 3.—The pile foundation process for the laying of piers C1 and C2

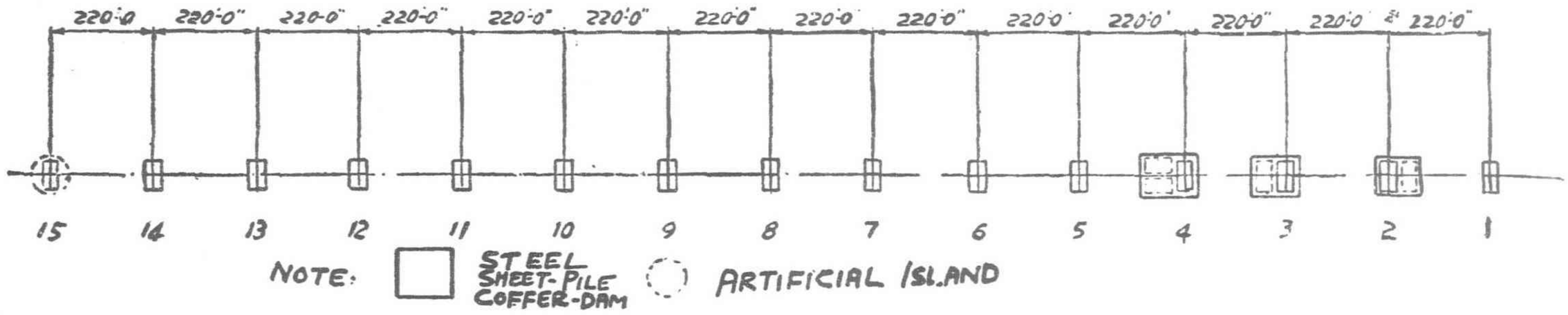


Fig. 7.—Diagram, reproducing the position of piers No. 1 to 15, as estimated for the second revision

required for a chromador steel member may be lessened owing to the high stress of the steel, the dimensions of the member are still limited by specifications not to be too small ; thus, it would be a loss to use chromador steel throughout the whole structure, even for very small section members. So, only for the main members, chromador steel is to be used, whereas, for the lateral systems, ordinary carbon steel is employed.

The Design of the Superstructure

The bridge was designed for duplicate traffic purposes,—railroad and highway. The depth of the truss designed is 35 feet, some

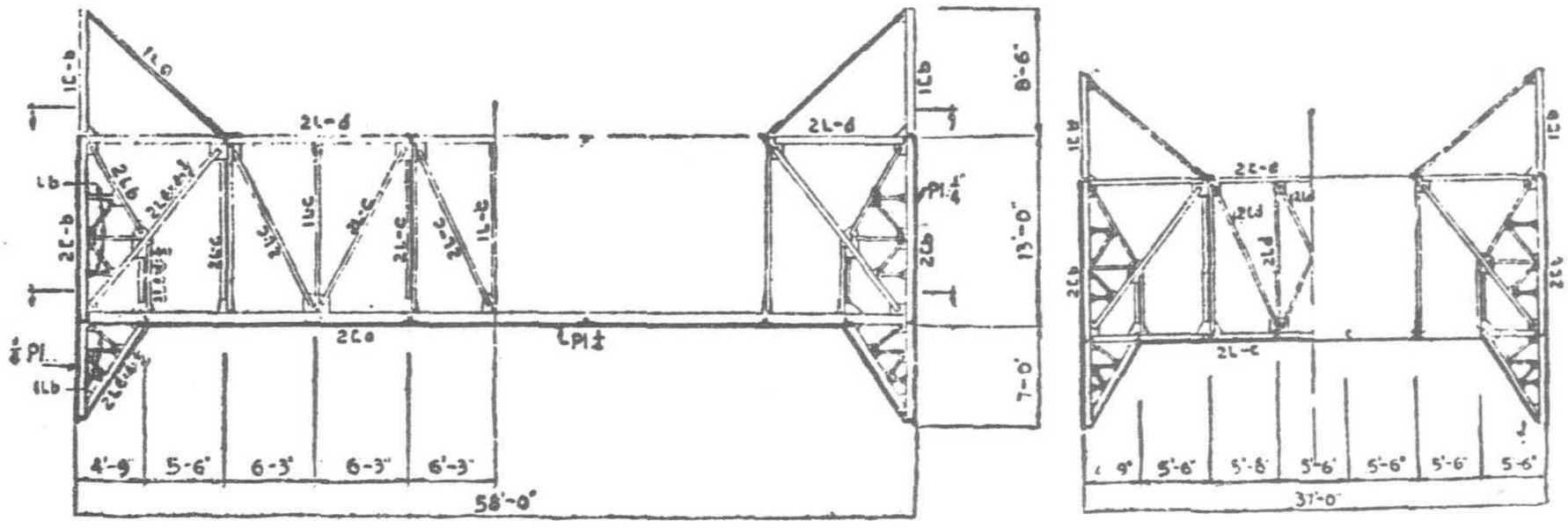


Fig. 9.—Drifting method of caissons skeletons, as adopted by the third revision

one-sixth of the span length. The total load of the upper and lower chords is 75 tons, the weight of the verticals being 65 tons. The width of the highway was designed to be 20 feet, same as the distance between the trusses center to center. The pedestrian sidewalks were designed to be supported on cantilevers. Particular features in the design of the superstructure of the main bridge are given in the following :

(*a*) Live Load

The live load on the railroad in the design is specified to be Cooper's E-50 loading ; that on the highway is specified to be trucks of 15 tons, whereas that on the sidewalk is 80 lb. per square foot.

(*b*) Allowable Stresses

The allowable stresses specified in the design are listed in the following :

Stresses	*Carbon Steel*	*Chromador Steel*
	(*All in lb. per sq. in.*)	
Tensile stress due to bending	16,000	24,000
Axial tensile stress	16,000	24,000
Axial compressive stress ..	16,000-60L/r not greater than 14,000	c(16,000-L/r) not greater than 21,000
Searing stress for web members	10,000	15,000
Searing stress for rivets riveted in shop	11,000	16,500
Searing stress for rivets riveted in field	10,000	15,000
Bearing stress for rivets riveted in shop ..	22,000	33,000
Bearing stress for rivets riveted in field ..	20,000	30,000

Since the maximum stresses are scarcely produced in ordinary highway and railroad constructions, the above listed values were later decided by the construction committee to be increased an increment of 12.5 per cent, except for those members which were designed to support either the highway or the railroad single-handedly.

(*c*) Intermediate Bracings

The intermediate bracings were designed both to resist the wind load and to support the highway slab, acting as cross-beams.

(*d*) Upper Lateral System

The ordinary arrangement of the upper lateral system is to use two or four angles connected by means of lattice bars. Owing to the arrangement of the cross-beams, which were designed to support the highway slab above, two angles are connected to the lower outstanding flanges of the upper chords to form the upper lateral system.

(*e*) Thickness of cover-plate and web-plate

According to the specifications of the Board of Railroad, the thickness of the cover-plate and the web-plate should not be less than the value given by the formula, $t=pd/4000$, in which t= the thickness of the plate, p= the axial compression, and d= the rivet pitch at the joint.

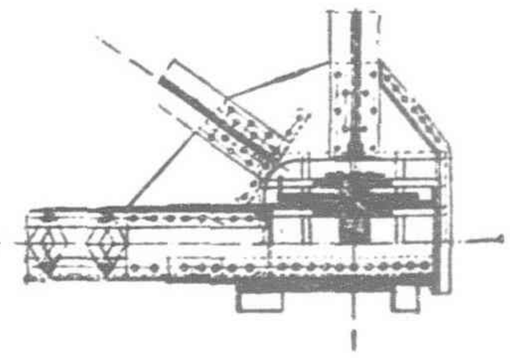
Since the above formula is not adaptable to high tensile steel, the A.R.E.A. specification is followed :

The thickness of the cover plate should not be less than one-fortieth of the rivet pitch.

The thickness of the web plate should not be less than one-thirtieth of the rivet pitch.

(*f*) End Bearings

The pin and the rollers are liable to be subjected to moisture and dust ; so, the upper portion of the lower chord is extended to the shoe and holes are punched on the bearing plate in order to be furnished with tarpaulin to protect the rollers. See Fig. 12.



(*g*) Lower Chords and the Tension Verticals

The angles of the lower

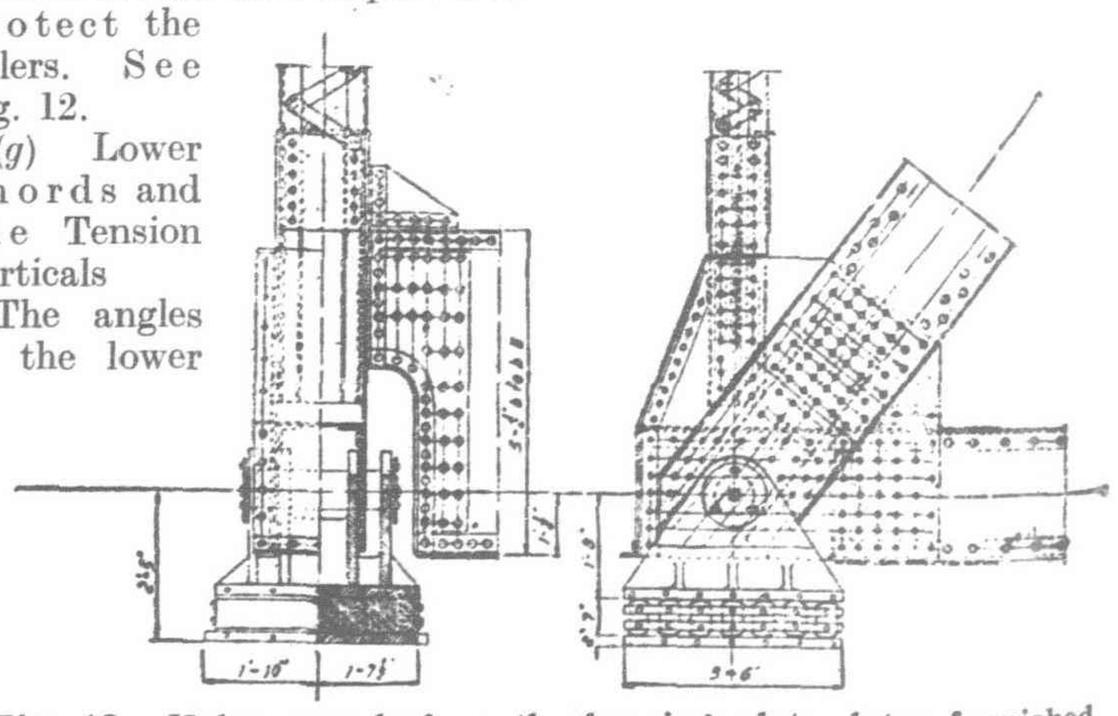


Fig. 12.—Holes, punched on the bearing plate, later furnished with tarpaulin, protect the rollers

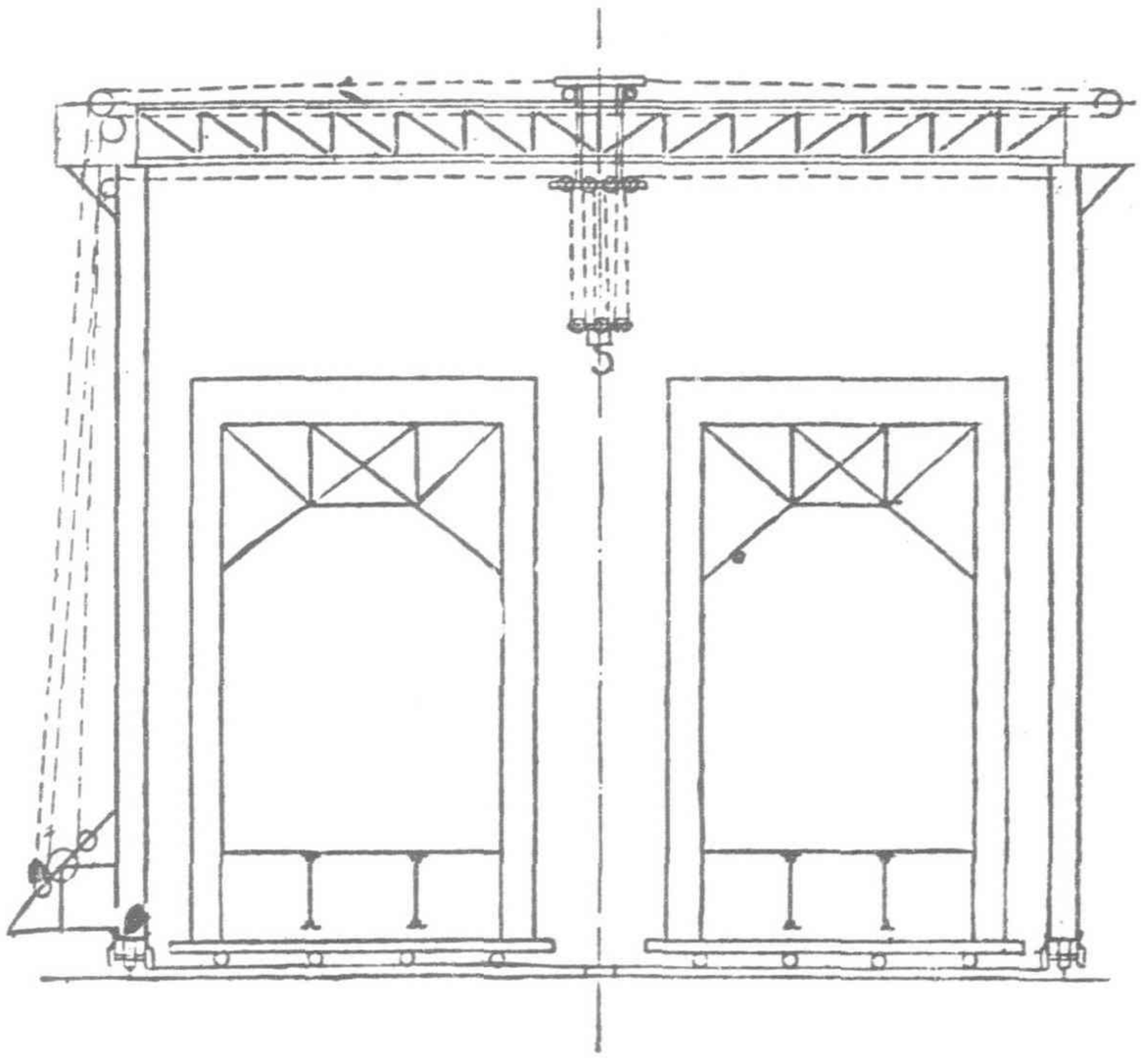


Fig. 14.—A portal crane, 58 feet high, 61 feet long, used for the transport of steel during the construction

chord member are arranged opposite inside ; thus reducing the required thickness of the tie plate. Very sound rigidity of the lower chord member is attained by connecting the floor-beams to the webs of the lower chord member.

The tension verticals are much more slender in their sections as compared with the lower chord member, for the tie plate being extended over the floor-beam does supply additional sections to sustain the stress in the verticals.

(*h*) Highway Cross-beams

The cross-beams supporting the highway are connected to the upper lateral system by using stiffening angles.

The main bridge trusses were all manufactured in England, and were superintended by R. W. Hunt Co. Physical strength and chemical composition were carefully investigated.

Erection of Superstructure

The erection of the superstructure required much consideration. After long, careful study, it was finally decided to erect the trusses by means of floating barks.

The trusses were all fitted up ashore in a fitting yard near the north bank. Steel was brought in on rails and was conveniently transported by effort of a very long locomotive crane with an arm of some 40 feet. A portal crane, 58 feet high, 61 feet long, shown in fig. 14.

With maximum possible loading of 15 tons, equipped with electric operating machine, also facilitated the transportation of the materials. The trusses were transported on wooden rails by means of two sets of steel wheels, each set consisting of four. The wheels were rolled by electric means to transport the truss to the floating barks, which were arranged as shown in fig. 16. When the truss was brought to its proper position in the river between two successive piers, it was then carefully arranged on the piers ; thus completing the erection process.

The Two Bridge Approaches

The span of the arch opening of the end approach, center to center of piers, is 164 feet ; the distance center to center between supports is 160 feet, say 56 feet shorter than the span of the truss of the main bridge. Since the approaches were designed for highway only, the loading is far less than that on the main bridge. It would be a waste to use high tensile steel, so ordinary carbon steel was selected as the construction material.

Owing to the difference of the geological content of the two banks, the design of the two approaches should have been different. However, for the purposes of harmonical bearings, they were designed of the same construction, Five different designs were made ; the final decision gives a double hinged arch structure with 160 feet span.

The erection of the superstructures of these two approaches were much simplified, since the approaches were almost all ashore. The trusses were all fitted up right in the working field instead of in the fitting yard.

The Drift of the Pneumatic Caissons

The pneumatic caissons were constructed ashore on the south bank of the river, some 5,000-ft. away from the location of the bridge. The caissons were made of reinforced concrete, 58-ft. long, 37-ft. wide, and 20-ft. high. They were all made hollow so as to be able to float on water. After the walls of the caisson skeletons proved strong enough, they were drifted to their respective positions and were then filled with concrete in order to sink themselves. The gross weight of a single caisson, before being filled up, is some 550 tons ; the depth to which the caisson sinks into water is nearly 15-ft.

The transportation of the caissons on land was effectively handled by means of beam hangers. Each hanger was composed of four sets of steel skeletons. Each skeleton was designed for a maximum load of 180 tons. Each two skeletons were arranged directly opposite and were connected by four 22-in. steel I-beams to form a group. Each two groups were arranged parallel and were connected by 4 by 12-in. grooved iron bars to form a hanger. The hanger was then possible for a maximum load of 720 tons. At either end of every two I-beams on the hanger, three layers of 6-in. by 8-in. wooden ties were arranged to support a piece of $\frac{3}{4}$-in. thick steel plate, which was furnished with a hole of 8-in. diameter at its center. A connecting rod 3-in. in diameter, was in the central hole of the plate and was well fitted up by means of screw and nut with a very thick washer. Six connecting rods were equipped on either side of the hanger, three at either end of the I-beams ; thus, each hanger was furnished with 12 connecting rods. When a caisson was hung, it was subjected to a total tensile stress of 50 tons. The lower ends of the connecting rods were all fitted with steel plates and 16-in. steel I-beams to support the caisson. The connecting rods themselves were arranged as lever arms in order to attain greater safety.

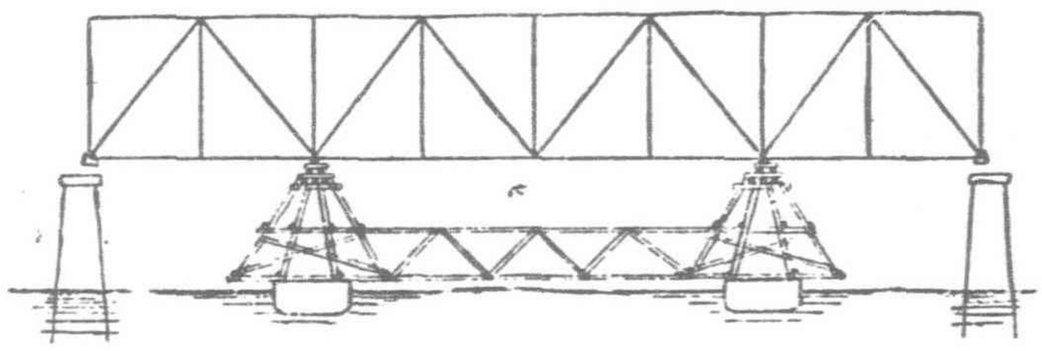


Fig. 16.—Diagram of the arrangement of the floating barks

Under each steel skeleton of the hanger, there were seven iron wheels, which were connected. Above each wheel there was arranged a semicircular iron disk connected to the horizontal axis of the wheels. The friction between the wheel and the horizontal axis was lessened by providing $\frac{1}{2}$-in. diameter steel tubes around the axis. The wheels were connected together by using two 4-in. by 12-in. grooved iron bars with seven holes to fit the seven axes ; the axes were tightly fixed by nuts. The two grooved iron bars were connected by angles and screws. Above the seven horizontal disks, 12-in. square wooden ties were arranged to support the steel skeleton.

The rails on which the wheels of the hanger rolled were a little different from ordinary rails. Two 90 lb. rails were employed to form a track on 14-in. square ties, the distance center to center of the rails being $9\frac{1}{2}$-in. Two tracks 44-ft. center to center were used to support the wheels. The rails were fastened and connected by fishplates and screw bolts ; long bolt of $\frac{1}{2}$-in. diameter were inserted between the rails at intervals of $6\frac{1}{2}$-ft.

The rails were all supported on piles. Owing to the different depth of the riverbed, four different arrangements were employed for the pile beats. The first arrangement was used for a distance of some 57-ft. from the bank into the river. Owing to the shallow water, two pine piles, 40-ft. long, were driven into the riverbed to form a set to support the track. The upper ends of the piles were closely connected ; the lower ends were some 8-ft. apart. The distance between each two sets of piles, center to center, was 3-ft. 4-in. At the top of each set, a 14-in. square wooden-tie was arranged to support the rail track. The second arrangement was employed for some 153-ft. in the river. Piles 50-ft. long were driven and

were arranged just as in the first arrangement was for some 57-ft. in the river. Piles 60-ft. long were driven; bracings were connected to the piles at 20-ft. intervals to attain sound rigidity. The fourth arrangement was for some 73-ft. in the river. Piles, 60 to 70-ft. long, were employed as shown in fig. 21.

The grade of the rail was 15 per cent; the total length of the rail tracks extended into the river on trestles was 340-ft.

The diameter of the wheel connected to the hanger is 30-in., the width being 15-in. The wheel was furnished with two smooth courses to fit the track and as connected to a hand wheel by gears so as to be movable by hand.

When the caisson was transported to the end of the track in the river, it was lowered to the water and floated on barks. This was accomplished by means of the screws on the connecting rods. However in revolving the screw nuts there was produced quite a great amount of friction. With a view to avoiding this friction, a special arrangement was designed with steel disk and rollers.

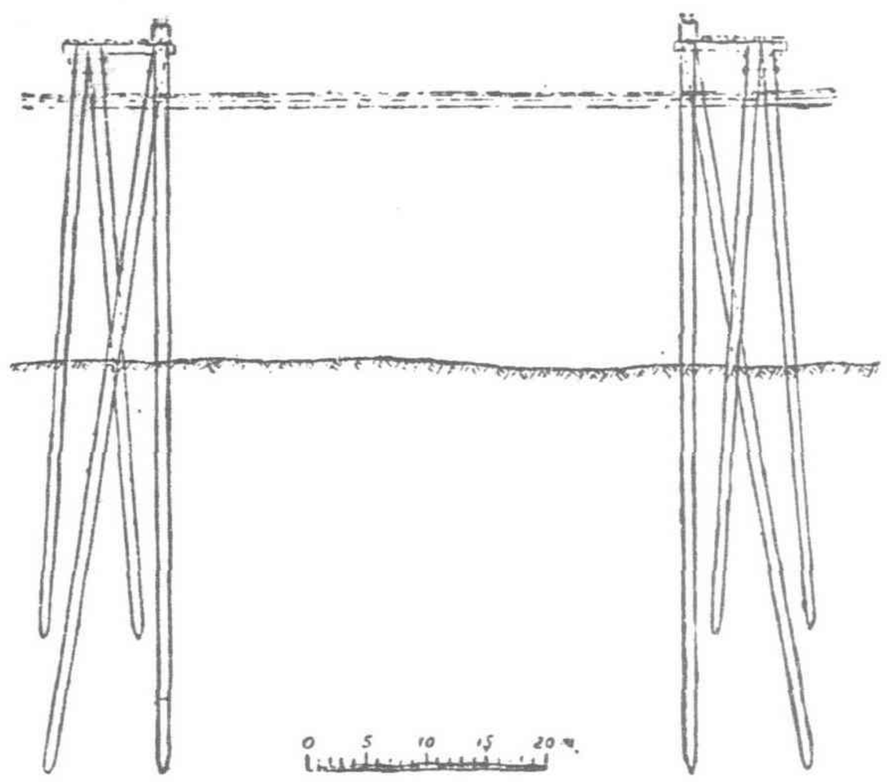


Fig. 21.—Piles, 60 to 70 feet long were employed for the sinking of pneumatic caissons

Sinking of Pneumatic Caissons

For the main bridge, the bottom of the piers had to be sunk into the riverbed some 70-ft. below. Owing to the existing liquid sand riverbed, it was impossible to excavate, so pneumatic caissons were employed.

Nearly all the caissons were constructed ashore in the construction yard, except that for pier No. 1 of the main bridge, which was practically constructed right in the field.

The location of pier No. 1 is not far from the north bank of the river, where the riverbed is comparatively higher and the depth of the existing water is only some 20-ft.; thus, it was not convenient to drift the pneumatic caisson. Steel sheet-pile cofferdam was first constructed with 184 pieces of steel sheet piles, 50-ft. long; water was then removed from the dam, mud and sand being excavated, gravel and stone were employed to consolidate the foundation; then, the pneumatic caisson was built up. It took some two months to accomplish this. The pier was then built up. When the pier was some 12-ft. high pneumatic instruments were fitted on the caisson. The caisson was sunk first by means of manual excavation. At first the excavated mud and sand was filled into the caisson walls to facilitate its sinking. Much care had been taken as to the amount of the pressure applied. In case the pressure was much in excess, the caisson would not sink but float. If the pressure was much lower than required, the caisson would probably sink too fast, as the riverbed is all composed of silt and sand, its bearing power being far less than required for supporting the caisson. In fact, owing to the excess amount of pressure and the uneven qualities of the riverbed, a caisson did once get inclined so much that the difference of the elevations of its two diametrical corners even reached 5-ft. The pneumatic process was then held is cessation and the caisson was righted by filling materials into the walls near the higher corner and drawing the filled materials cut of the walls near the lower corner. The caisson was thus made upright again. The pneumatic process was continued and the caisson went on sinking as the pier was built up. At first, from 1-ft. to 32-ft. owing to the soft clay and liquid at the bottom, the caisson tended to sink much quicker, so comparatively high pressure was required to keep the caisson from sinking too fast. From 33-ft., to 47-ft., the riverbed is composed of gravel and stone and the bearing power is much higher; the pressure required was then much smaller than estimated.

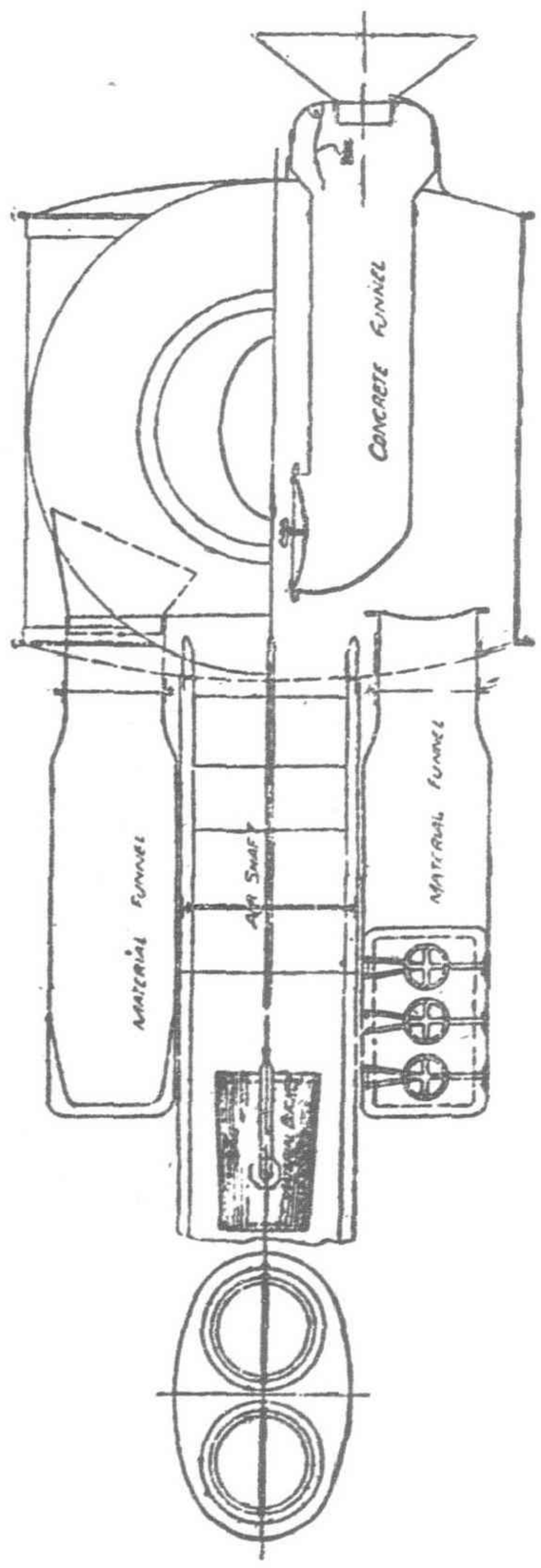


Fig. 24.—Air lock connected with an airshaft, arranged at the top of the caisson to controll the air-pressure, to keep the workmen immune from caisson diseases

Air was compressed into the caisson by means of an air compressor. On the north bank, four compressors were arranged for use, two of which were made in the United States, each being capable of pumping air at a velocity of 500 cu. ft. per min. The air pumped was first admitted to an air box and was then transferred to the working chamber by air tubes.

An air lock connected with an air shaft, fig. 24. was arranged at the top of the caisson. In the air lock, a clay hoist was arranged with several funnels. On one side of the air lock there was connected a decompression chamber in which the air pressure was a little lower than in the working chamber and through which the workmen would enter. The clay hoist consisted of a gear wheel and a chain, on both ends of which buckets were arranged to transport the excavated soil. The hoist was operated by means of a 3 h.p. motor. See fig. 25.

Safety Device Workers

Owing to the high pressure in the working chamber, workmen were easily subjected to injury; therefore, a safety air lock was furnished in which the high pressure might be gradually reduced to be equal to the ordinary atmospheric pressure; workmen subjected to caisson diseases were often kept in it to recover.

The process of excavation was different for different geological conditions. When the caisson was sunk into ordinary soil layer and when the pier was held upright, excavation was held by radiation method, that is, from center to the four sides. If the pier was held inclined, it was naturally the way to excavate the soil right from the opposite side of the inclination with a view to keeping the pier upright again. When the caisson was sunk on rock stratum, care had to be taken to prevent the edge of the caisson being ruptured.

For general proceeding of excavation in ordinary sand riverbed. First, a piece of platform was left under the air shaft for supporting the buckets of the hoist; excavation was then commenced around the platform.

When the caisson reaches the rock stratum, it is necessary to excavate first around its lower edges in order to prevent it from being ruptured when the caisson sinks. The excavation of the rock around the edge was practically carried out in the proceedings as indicated by the numbers in the figure.

The excavated soil in the working chamber was transported by the buckets of the hoist and was carried outside by the material funnels. For ordinary excavation in soft soil, some 23 workmen were employed within the caisson. When the caisson was sunk to rock stratum, it proved much more difficult to excavate; so, more than 30 workmen were employed. For 24 hours, with continual excavating, the caisson would sink 9-in.

When the caisson was sunk to rock stratum and when the pier was right at its proper position, concrete was then filled into the working chamber. High pressure was applied to prevent leakage of water; concrete was mixed right in the chamber, and was first filled all over the bottom for certain

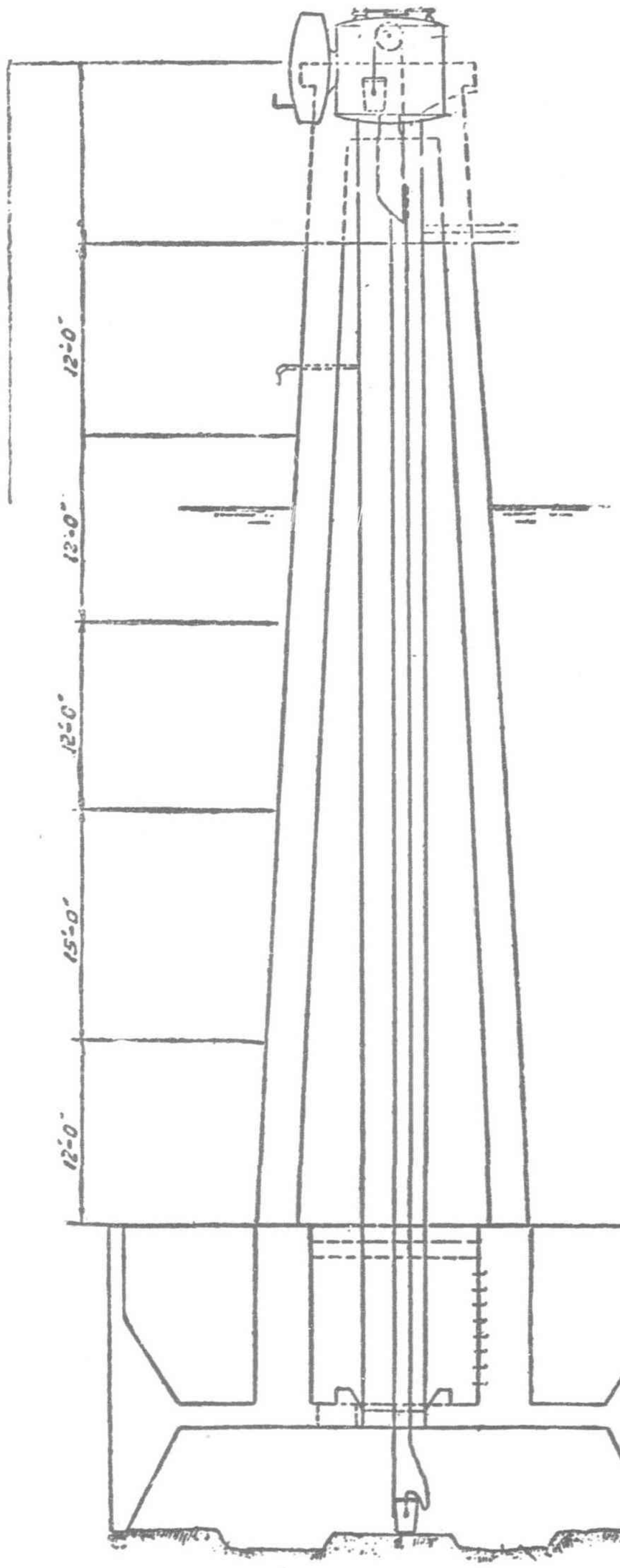


Fig. 25.—Diagram of the excavation operation

depth and was filled again from the four sides to the center, layer after layer, each layer being 6-in. in thickness.

The Piling Work

The rock stratum under piers No. 1 to 6 is comparatively higher ; no piles were needed for their foundation work ; however, for piers No. 7 to 15, the rock stratum is much lower so piling work played a very important part.

Piles were all driven by means of 5.8 ton steam hammer pile drivers which was arranged on a large steam bark with cranes, pulleys and leader. The hammer was guided and controlled by means of chains and capstans. Since the hammer was only able to drive the piles above the water level, a special design of guiding piles was used. The guiding piles were practically steel cylinders, 60-ft. long, equipped with steel caps at both ends to fit the hammer above and the pile driven below. The weight of each guiding pile was approximately 5 tons.

Sometimes, the guiding pile would be driven to some 40-ft. into the riverbed. Very large skin friction was produced between the surrounding mud and its lateral surface, so pulleys were arranged on the crane to pull it out when the wooden pile was at its proper position.

The proceedings of the piling work were as follows :

(1) First, the pile to be driven was lifted up to the top of its guide.

(2) The pile was then arranged at its position in the guide under the hammer.

(3) A steel cap was fitted at the top of pile in order to prevent it from being split.

(4) The pile was then fixed at its right position by means of iron bracing.

(5) The position of the pile was adjusted by moving the bark, and was readjusted after the pile had been driven by light blows.

(6) When the pile was fixed at its position, all materials originally used to lift the pile, was removed.

(7) Steam was raised and driving was started.

(8) When the pile was driven to a certain depth the steam-hammer and the cap were all removed and lifted again.

(9) A guiding pile was then fitted right above the pile driven and below the hammer.

(10) Steam was operated again and the pile was driven by means of the hammer on the guiding pile right to the bottom of the riverbed.

(11) When the required depth was reached, the hammer and the cap were all removed and lifted.

(12) The guiding pile was then pulled out, and the piling process was completed.

Ordinarily when a series of piles were to be driven, they were driven first at the central portion of the foundation ; the earth around these driven piles would be tightly packed together ; piles then driven were liable to be inclined instead of being vertical. Several means were devised to pull these inclined piles out again. The best method was to use the water jet. A Worthington steam hydraulic engine was arranged on the bark, being capable of pumping 500 gal. of water per min. ; its maximum pressure head being 300 lb. per sq. in. Steel tubes, 6-in. in diameter, were connected to the engine to form the jet. The length of the jet was different for different depths and was provided by connecting steel tubes, each 20-ft. long. At the lower end of the jet, a short nozzle was furnished, for ordinary sand soils, the water jet was often employed to drive piles and proved effective.

Sinking of Open Caissons

For the north approach, piers A and B were all located right on the bank ; therefore, chiefly for economy of time and safety, open caissons were employed as dredging wells. The caissons were all made of reinforced concrete, being 52-ft. high, 14-ft. wide, and 19-ft. long. the thickness of the caisson wall was 4-ft. The reinforcements arranged around one wall were: $72\frac{3}{4}$-in. steel vertical rods around its outer circumference ; $18\frac{3}{4}$-in. steel verticals around its inner circumference. The footing of the wall was sloped outward at a rate of 1 : 20. In construction, the caisson was divided into four sections. The first section was 14-ft. in height ; the second and third sections were both 13-ft. and the fourth section was 12-ft. in height. At first, the caisson was

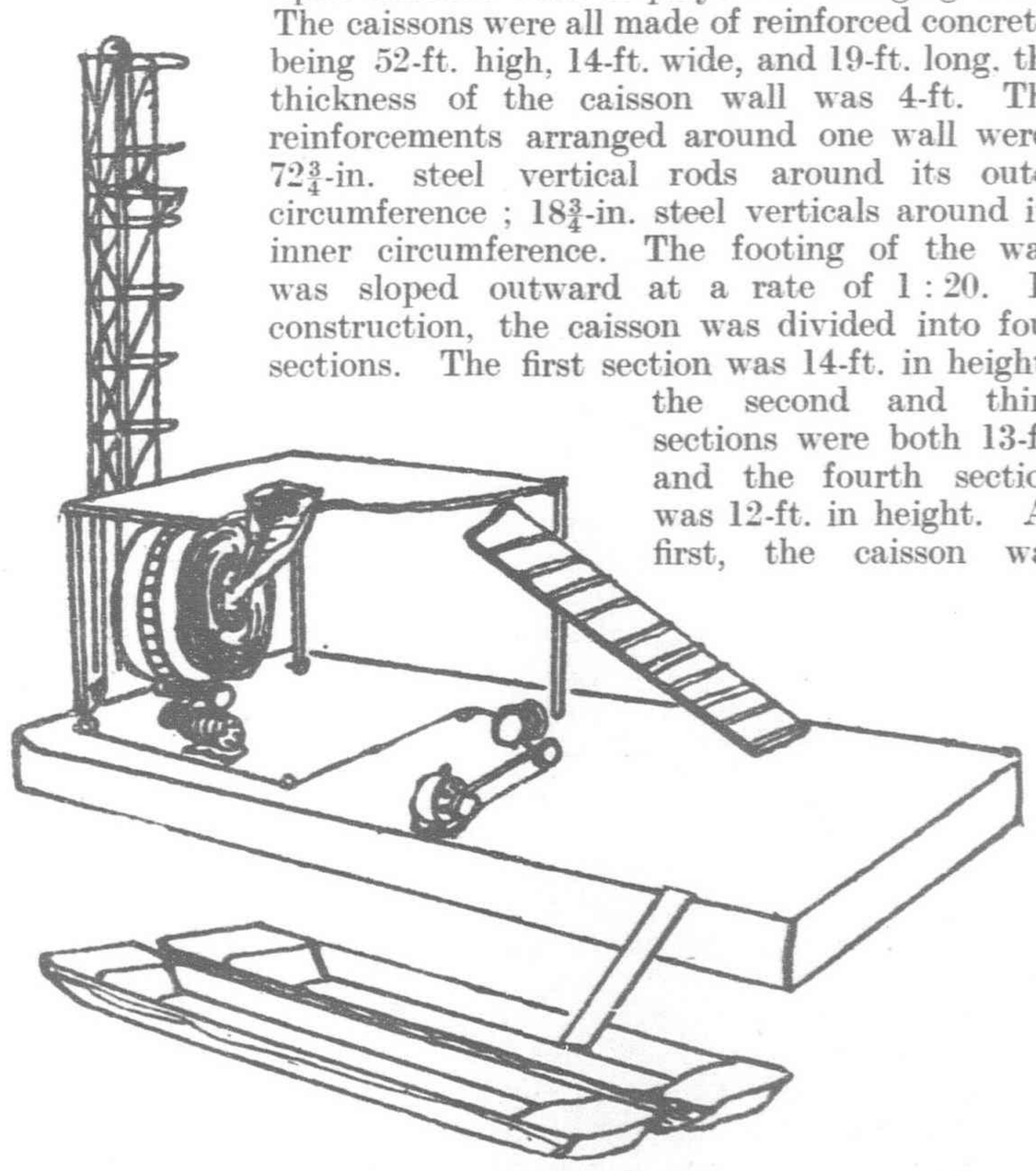


Fig. 42.—Mixers as employed on floating barks for the construction of piers in the river

sunk through mud and sand; excavation was by manual work only. The sinking rate was some 12-in. each day. The caisson was liable to be tipped up and down owing to the uneven distribution of the geological contents. Once the caisson even sank at a rate of some 3-ft. a day. When the caisson was held inclined, excavation was started at the portion opposite to the inclination with a view to keeping it upright again. However, the caisson was too small to attain this effect. Therefore, wood bracings were braced to keep the caisson from being inclined. When the fourth section was sunk into the earth, the caisson practically rested on rock stratum, which is actually not far from the ground surface. Undermined water was then pumped outside and concrete was filled in the caisson at its bottom.

The Concrete Work—Material Employed

(1) Cement.

Since the river is subjected to sea flows, the concrete piers of the main bridge will be seriously affected by the salt water. Therefore, special cement was employed for the piers of the main bridge, whereas, for the piers of the approaches, ordinary portland cement produced by China Portland Cement Co. was brought into use.

(2) Sand.

The property of the sand used has much to do with the property of the resulting concrete. After serious study and repeated experiments, sand produced in Fuyang, Chugee and places near the Chien Tang River was brought into use. The fineness, and the sharpness of the sand used were practically suitable ; however, its condition proved a defective point. The sand had to be washed before being used.

(3) Stone.

For ordinary proportions of concrete, the stone used was practically 1-in. in size, except that used for 1 : 4 : 8 concrete, being some 2-in. in size. The stone used was mostly green gravel, which was produced on a mountain, called " Mantao Shan," in Fuyang.

(4) Water.

The salt water in the river was practically unavailable. It would have cost too much to get machinery for water supply, so on the north bank water was taken from the mountain streams ; on the south bank, water was suctioned from small ponds.

(5) Steel.

All the steel used was manufactured by open hearth process. Deformed and plain rods were both employed. Most of the steel rods used for the main bridge were bought from Portland, while those used for the approaches were from Germany.

Forms

Most of the forms for the concrete work of the approaches were made of wooden planks ; whereas those used for the main bridge were composed of steel sheets. Particular features of the forms are given in the following :

(1) For the main bridge, forms of the pneumatic caissons were braced inside the caisson.

(2) The forms of the open caissons for the piers of the approach and those of the piers of the main bridge were all made of self-supporting arrangements.

(3) The forms used for the piers on the south bank were made of sheet-pile cofferdams.

(4) The forms of the wall of the piers of the approaches were supported by wooden scaffoldings.

(5) The forms of the slab of the bridge were supported on the truss members.

Concrete

Six different proportions of concrete were employed for different structures :

1 : 1 : 2 Used for structures under the supports of the steel superstructures.

1 : 2 : 3 Used for the structures on the superstructure of the approach and for the footing of the open caissons.

1 : 2 : 4 Used for the pier wall of the main bridge and the highway slab and auxiliary structures like wing wall and rails.

1 : 2 : 5 Used for the walls of the piers and open caissons of the approaches.

1 : 3 : 6 Used for the footing of the piers of the approaches and for filling the caissons after they were sunk into their proper positions.

1 : 4 : 8 Used for filling the excavated foundations of the piers of the approaches right on rock stratum.

All the concrete used was mixed by means of machine mixers. Thorough mixing was shown by the color of the resulting concrete. In mixing the concrete, slump test was often held to investigate the ratio between the amount of water and cement.

The mixing yard was different in arrangement for different conditions of the work.

(1) For structures comparatively lower on land, the mixing yard was arranged simply.

(2) For structures comparatively higher on land, the same arrangement was made as in (1), except that a wooden skeleton, furnished with hoist, was erected chiefly for purpose to transport the mixed concrete.

(3) For the construction of the piers in the river, mixers were arranged on floating barks, as shown in fig. 42.

For transportation of the mixed concrete to higher structures, skeleton tower and hoist were arranged. Ordinarily on land, wheelbarrels were employed. In connection with the work in caissons, buckets were used.

The placing of concrete into the forms was different for different structures.

(1) For filling at the bottom of piers and caissons, concrete was continually laid right from the bottom, layer after layer, each layer being some 6-in. in thickness.

(2) For the walls of the piers owing to the complicated arrangement of the reinforcement therein, concrete was laid continually, but not necessarily once as a whole, layer on layer, each layer being 6-in. in depth. However, when work was interrupted, although the wall was not necessarily completed, the top of the filled concrete must be well arranged as a level surface so it could be continued the next day.

(3) For the structures on the superstructure, as they were all connected with the road slab, concrete had to be placed at the same time as that for the slab. The joints at which the placing of concrete was temporarily held at cessation must needs be located at sections of minimum shear.

(4) For the highway slab, concrete was placed so that the temporary joints at cessation of work were located right at sections where connecting reinforcement was provided at both the top and the bottom of the resulting slab, the extremities of the stringer being right at the middle of the span of the slab where shear occurred to be minimum.

After certain elapse of time, the forms were removed ; the resulting concrete work was then finished by painting with 1 : 2 cement mortar and moldings were made to add more or less architectural beauty to the existing structures.

" Sian: A Coup d'Etat " is Best-Seller

The de luxe edition of Sian : A Coup d'Etat, which comprises a vivid account by Madame Chiang Kai-shek of her thrilling activities during the fateful days when the Generalissimo was under detention in Sian, and extracts from the diary that the Generalissimo kept during that anxious period, has proved to be a best-seller in China and undoubtedly will be received with world-wide interest. Apart altogether from the literary merits of the contents, the format of the book is unusual and attractive. It is printed on specially prepared Chinese paper, made by hand, from bamboo fibre and is bound in Chinese silk with a brocade back. The cover bears, beneath the title in English, Chinese characters in gold written by the Generalissimo. The book is printed by Messrs. Kelly & Walsh, Ltd.

Many of the Generalissimo's bodyguards were killed during the troubles at Sian, and the entire profits derived from the sale of the book will be devoted to the support and education of the orphans and the relief of the widows.

Earthquake Movements and Engineering Structures

By Prof. G. G. NARKE, M.A., M.S.C.

(This paper was read by Professor Narke before the Bombay Engineering Congress of 1935, and was published in the March, 1937, number of the Journal of the Association Engineers of Calcutta)

DURING the course of discussion on paper on the water supply in Baluchistan, I mentioned that I should not be surprised to hear of an earthquake in that neighborhood. The earthquake has happened. The area affected was less in extent than in the case of Bihar, but the loss of life and property was on a much bigger scale. In the Bihar earthquake about 900 miles of railway line were destroyed, 361 bridges were damaged and 2,000,000 acres of cultivable land were affected out of which 200,000 acres were a total loss, the fields and countryside being covered with sand. That shock lasted for five minutes and was felt over an area of not less than 1,900,000 square miles. The area suffering greatest destruction was one of the most densely populated districts in the world and had it not been the busiest time of the day when people were working out of doors, the loss of life would have been colossal. The Quetta disaster is still shaking the land. The zone of the greatest destruction passed through the Quetta valley and the town was entirely demolished. About 40,000 lives were lost in the neighborhood of Quetta itself and property worth crores of rupees now lies buried under the debris of the town. It is not necessary here to give a detailed description of the damage wrought and the effects produced, as these have already appeared in the Press. Engineers should know the causes of such phenomena, the hypotheses underlying them, whether it is possible to be forewarned against them and how to build structures which will withstand them. I have drawn my conclusions from what has appeared in the Press and from reports of similar disasters elsewhere.

There is ample undeniable evidence that birds and animals know as much as twenty-four hours ahead of such impending disasters, due, it is said, to instinct. Instinct, however, is a gradual growth of knowledge derived from past experience. On the other hand science has solved many problems of everyday life. We have departments which give us forecasts of sunshine, weather, rain and winds. We pay particular attention to the daily reports issued by meteorological offices as they give us timely warning of possible dangers to our shipping and our aircraft. We find out the depth of oceans without the use of a sounding line by reflected vibrations and detect the approach of a monster iceberg long before our lookout in the crows nest has sighted it. We flash the news of high floods down a river and take precautions to protect our bridges and dams against a heavy rush of waters by opening our sluice gates before the river rises. Engineers anticipate these and other dangers and have a margin of safety in foundations and structures. Why is it not possible to provide safety factors in the case of engineering structures likely to be subjected to earthquake movements? My answer is that it is possible. A use of suitable materials, a proper orientation of the buildings, the fabrication of the whole into one solid block capable of vibrating in unison with the molecular wave-motions produced in earthquake movements,—all these together would preserve structures and reduce damage to the minimum. A visitor—say an engineer—from a neighboring planet, would laugh at our ignorance when he saw whole towns destroyed in a few seconds by an earthquake disaster because they were not properly built. He would not blame the disaster because he would know that that was unavoidable. What he would not understand would be the failure to take precautions when erecting structures in the heart of a seismic zone.

Both Bihar and Quetta valleys are pronounced seismic areas and earthquakes frequently occur in these localities. If you study the traditions and proverbs of the masons and building craftsmen of those localities you will get some useful hints. They will tell you, for example, to lay out your buildings with their length in a S.W.-N.E. direction, which incidentally is a direction in which earthquake waves are known to do the least damage.

Two important points must be taken into consideration, viz.: (1) The seismic areas in India and (2) the precautions to be taken in erecting structures in those areas. For a proper understanding it is necessary to study the theories concerning earthquake phenomena and what has happened to structures in seismic areas. I propose to explain the former in this paper and deal with the second by

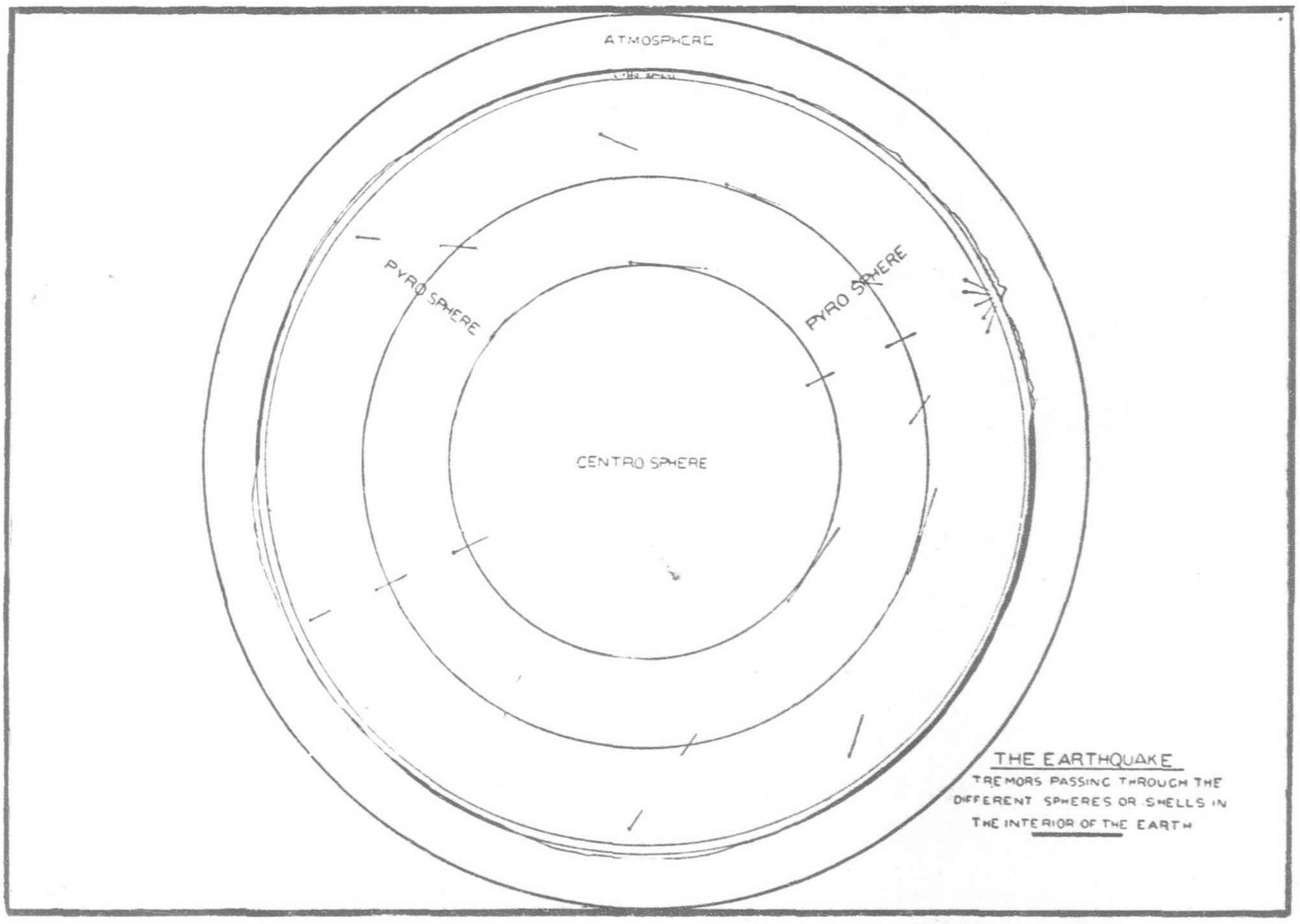


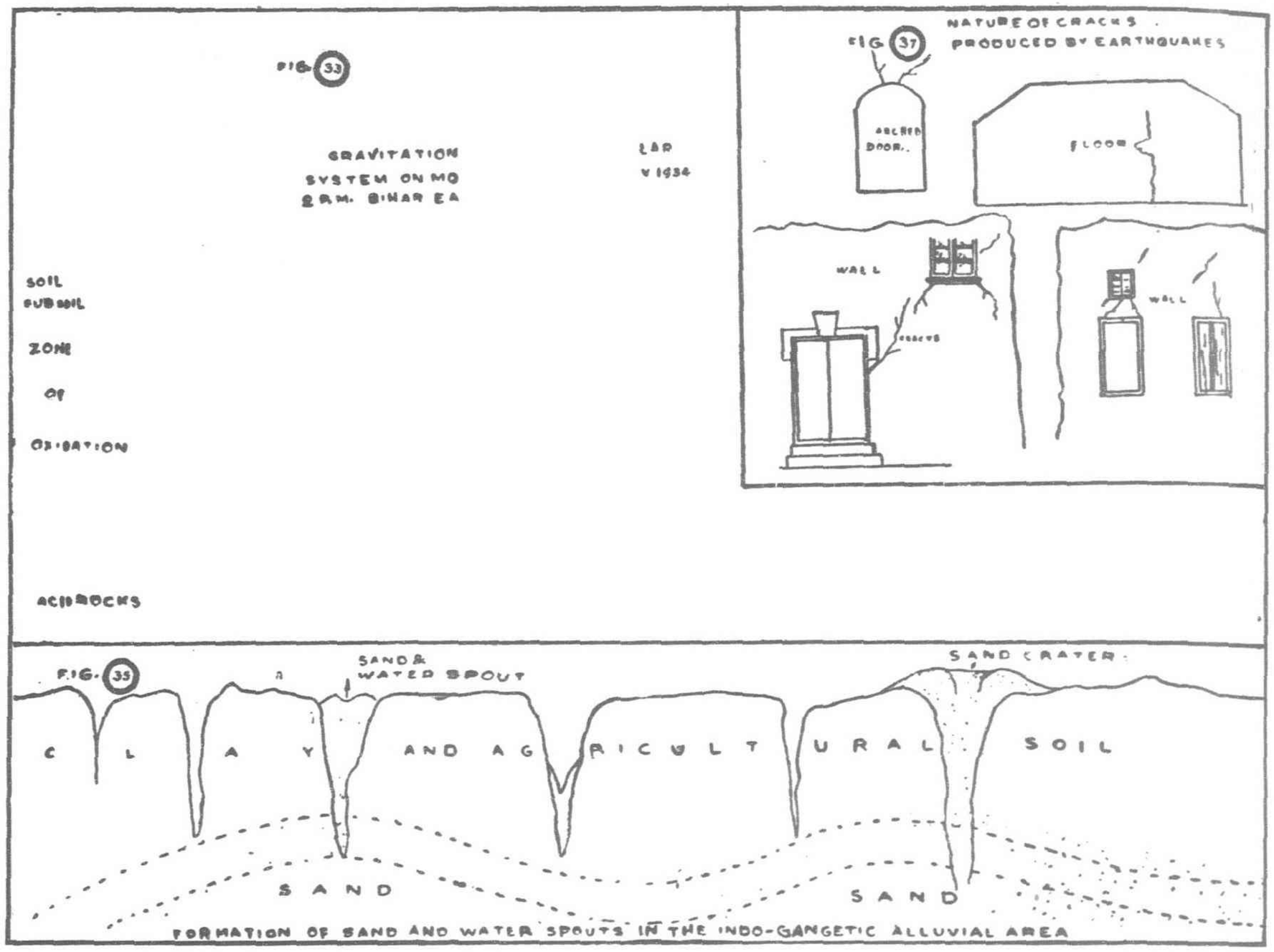
Diagram of the Earthquake Vibrations along the Surface of the Globe and through the Interior of the Earth

drawing on statements made by engineers on what they have observed and on what, in their opinion, could have been done with advantage in the areas affected. A beginning can conveniently be made by studying the causes of surface undulations produced in earthquakes, together with their nature and the effects produced by them.

Dynamic Agents at Work on the Surface of the Globe

The earth has the shape of an oblate spheroid. Its equatorial diameter is 7,926.7 miles and its polar diameter is 7,900 miles. On its surface there are dynamic agents ever at work producing changes of land and sea areas. The surface of the oceans seems to have been at the same distance from the center of the earth since the earliest geological times, but the land area has undergone great changes of level and is regarded as being more mobile than the sea area, this being expressed in the phrase "the mobility of the land and the stability of the sea." The causes of earthquakes may be found in this mobility and stability and are due to the dynamic agents at work on the surface of our globe. These are of two kinds—(1) sub-aerial and (2) subterranean. Air, rain, rivers, glaciers and sea are the sub-aerial agents. They act both chemically and mechanically in bringing about the deterioration of the land area and washing it down to sea level, transporting billions of tons of sediment from the land to the sea in the process. This enormous transfer of material from one place to another entails readjustments of the centers of gravities of the parts of the globe affected and movements *en bloc* are produced in the earth's crust. These, along with other causes, produce pressures which are only relieved by the sudden yielding which is the direct cause of an earthquake.

Subterranean agencies are self-explanatory. Volcanoes and deep fissures bring up to the surface enormous quantities of lava and ashes. The Bombay and Poona rock, the Deccan trap, which now covers an area of more than 200,000 square miles to a depth of thousands of feet is an example of this extrusion. Mountain building forces, i.e., slow crust creep movements which have thrust up formidable mountains like the Himalayas, Caucasus and Alps



The upper right diagram shows the nature of cracks, produced by earthquakes, while the lower reproduction shows the formation of sand and water spouts in the Indo-Gangetic Alluvial Area

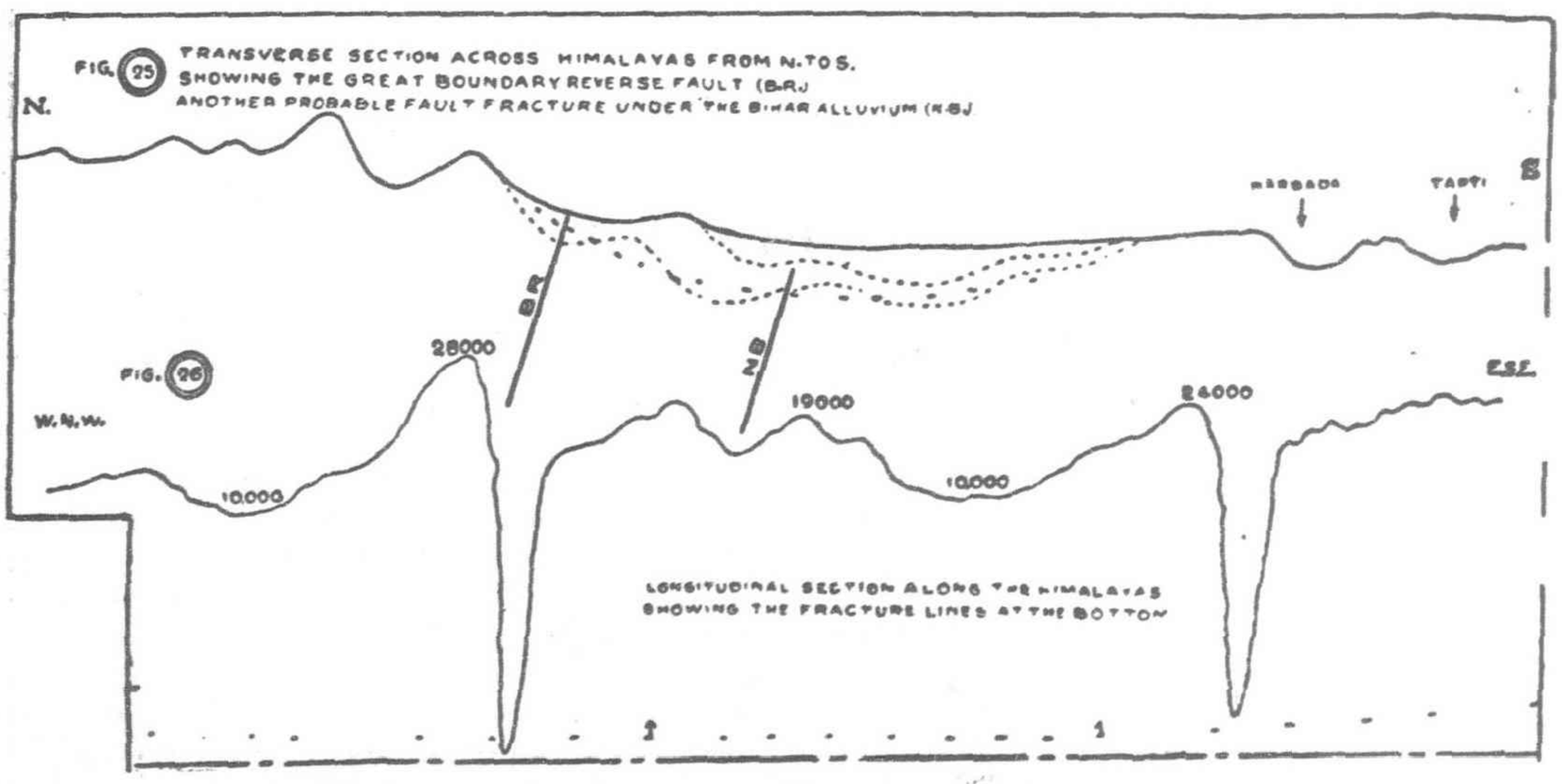
The Interior of the Earth

The first difficulty is to decide on, the actual composition of the interior of the earth. Various theories have been put forward to answer this question, our direct evidence on this point being very meagre. Out of the 4,000 or so miles radius of the globe, only a scratch of about 10 miles in depth gives us direct evidence, nor do volcanic vents seem to go down to very great depths. Earthquakes have their origin at still greater depths, a deeper origin giving a greater shock. In very big earthquakes the whole globe is shaken and vibrations reach the opposite end of the earth's diameter both along the surface and through the interior of the each, as shown in Fig. 1.

Four important theories have been put forward on the internal composition of the earth. These are :—

(1) A solid crust resting upon a molten magmatic sphere enclosing the original nebulous material at the center
(2) A solid crust resting upon a molten sphere, with a central hub of solid heavy metals at the center
(3) Solid from surface to the center
(4) Solidified throughout with cavities in the interior.

As the average density of the earth determined by astronomical calculations is 5.67, the third theory seems unacceptable, as, if it were true, the density should be much higher, the density of the surface rock itself being 5.6. Any one of the remaining theories may be true. The earth may have been formed either by the gradual cooling of the hot nebular gaseous mass or by the accretion



Transverse section across the Himalayas from North to South

of meteoric matter. In the former case the original nebular heat would be retained by the formation of a thick surface layer of rocks and in the latter case the heat would be produced by the impact of meteoric matter on the surface of a growing globe, gases and water vapor being simultaneously produced and confined in the body leaving enormous cavities within, on condensation. Thus under both of these theories, the globe may be supposed to consist of an uppermost rocky crust, called the lithosphere, resting on an inner pyrosphere of molten magmatic material enclosing still underneath a barysphere or sentrosphere of unknown constitution. The temperature underground rises steadily at the rate of 1°F. per descent of 60 to 70 feet. Allowing for the enormous static rock pressures as we go deeper and the corresponding rise of the fusion temperature, the rock crust obviously extends to far greater depth than the maximum depth of the origin of earthquakes which is found to be not more than 30 to 40 miles. In the study of earthquake movements, therefore, we are concerned only with the outermost rocky lithosphere and the immediately underlying pyrosphere made up of molten rock materials. The pyrosphere and the innermost central part of the earth, however, seem to behave as a homogenous mass with the consistency of a steel sphere. Through them the earthquake vibrations travel at a uniform velocity, greater than that obtaining nearer the surface.

Earthquake Waves

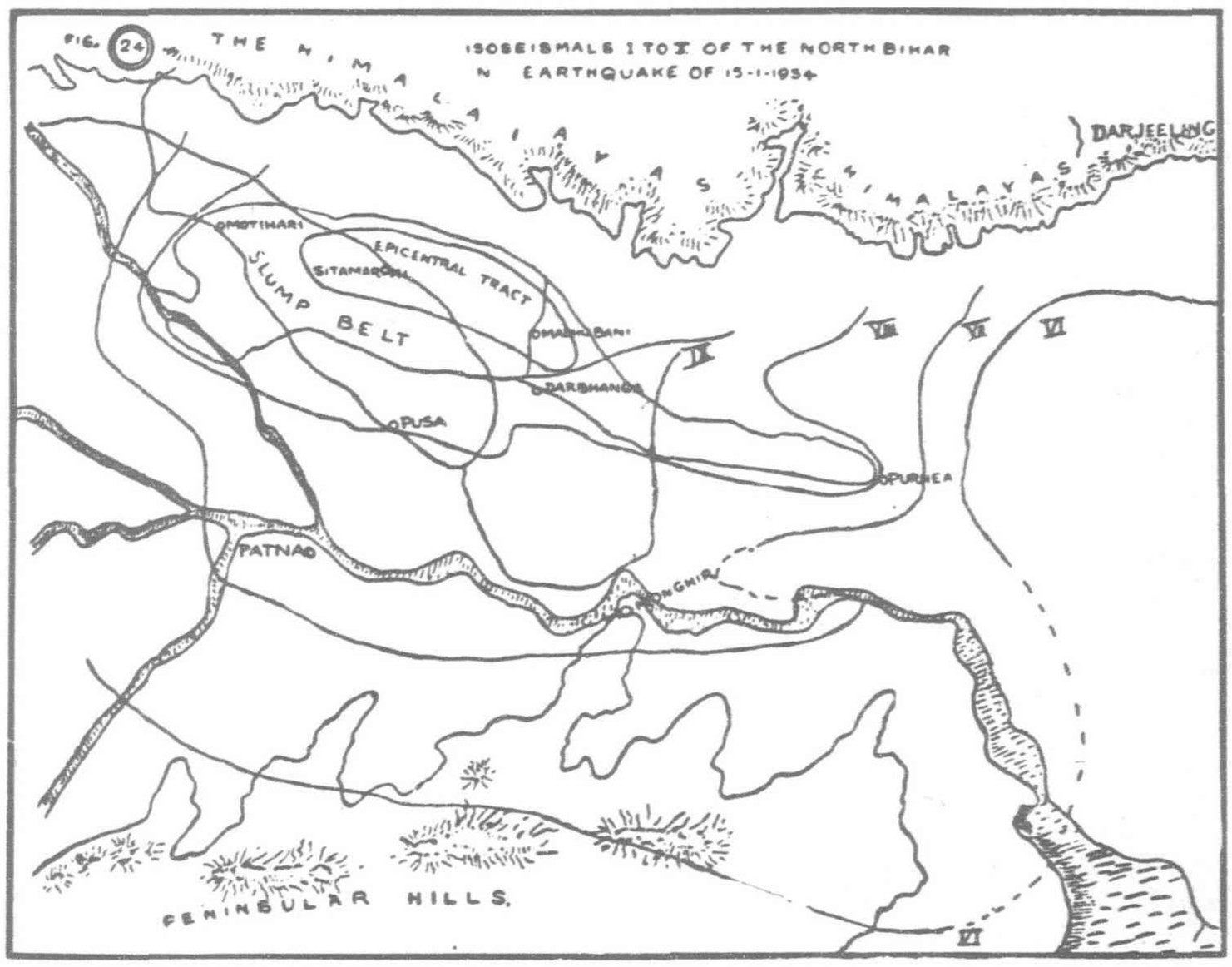
Earthquake waves are molecular breaks in the solid rocky portion of the earth's crust and are produced by sudden displacements of enormous masses in the crust, at great depths. They are propagated through the substance of the rocks and also travel along the surface superficially and are, in fact, very rapid undulations of the crust. Let us first consider the two chief types which are:—(1) Condensational and (2) Transversal. In the condensational waves the particles move in the same direction as that of the propagation of the wave and in the transversal the motion is at right angles to the direction of propagation. Condensational waves may be likened to sound waves in air or other fluid, and travel at a higher velocity than transversal waves, moving at rate of seven miles per second at the surface. They produce changes of volume only and owing to their higher velocity they arrive earlier than the transversal waves. They are readily communicated to the atmosphere and are cause of those rumbling and thunderlike sounds preceding a main shock. The intervals of times between the arrival of these and the transversal waves give an indication of the distance of the origin of the earthquake. They are also subject to reflection and refraction due to the heterogeneous nature of the rocks through which they travel and also owing to the reflection and refraction of the sound waves. These come up to the surface with varying degrees of pitch and intensity, producing noises resembling those of a train passing through a tunnel, or the passage of a number of motor lorries nearby, or the distant booming of artillery. All these sounds were heard distinctly in the Bihar and Quetta earthquakes and all had a definite amplitude and period.

The transversal waves are those of elastic distortion and travel at about $\frac{2}{3}$rd the velocity of the condensational waves. These waves give the main and after shocks and produce the greatest destruction. Transversal waves can only be produced in solids and may conveniently be represented by a harmonic curve.

The point vertically above the origin of an earthquake is called the epicenter. In big earthquakes yet another set of surface waves of great length and long period appears to start from the epicenter and spread around it in all directions. These waves are propagated to great distances with a constant velocity and are felt as surface undulations. These undulations were distinctly observed in the Bihar earthquake.

During earthquake tremors earth particles move both radially and horizontally. Of these two movements the horizontal ones are more dangerous. The actual range of the horizontal movements varies; when it reaches $\frac{1}{2}$-in., damage is done to the surface, and a 1-in. horizontal range is found to be very destructive while the havoc caused by a 9-in. to 12-in. range can be imagined. The periods of vibration vary between $\frac{1}{20}$ second and $\frac{1}{5}$ second and the duration of the tremors may be from one second to three minutes, but in the case of very big earthquakes the duration may even be 6 to 12 minutes. To reiterate, a deep seated and severe disturbance in the earth's crust thus gives rise to three distinct wave motions. Of these, two are propagated through the earth at different velocities and the third over the surface from the epicenter and three distinct phases of vibrations are therefore recorded at the seismographic observatories. The first two phases constitute the preliminary tremors, travelling through the earth at six—seven miles and three miles per second velocities respectively. The main shock is caused by a set of large vibrations travelling over the surface of the earth at two miles per second. All the vibrations get reflected and refracted in various directions, and it is the waves which get reflected which are known to cause the main destruction on the surface.

The velocity of the earth particles changes during the vibrations, the rate of change being the acceleration. Damage to earth structure is caused when the acceleration produces stress which exceed the elastic limit of the solid rock.



Sketch, reproducing the movements of the North Bihar earthquake of 1935

Important Terms Used in the Description of Earthquake Phenomena

(1) The "Center" or "Origin" is the point deep down in the crust of the earth from which the earthquake tremors originate. This is also called the "Centrum."

(2) The "Epicenter" is the point on the surface of the earth vertically above the centrum. The tremors arrive here first, travelling along the radius of the earth, the condensational and transversal waves reaching this point almost simultaneously, which means that the subterranean sounds and shock are heard and felt practically together. Although the intensity of the waves here must be very great less damage is done owing to the angle of emergence being zero. An up and down subsidence movement is felt, causing in an alluvial area widespread slumps. The epicentral region, therefore, is a "slumping zone." The surface undulatory waves originate at this point and spread around it in circles or ellipses. I may say that earthquake movements are rarely simple, and generally have two focii. These have two corresponding epicenters lying on a line with a definite bearing on the surface, this line being the projection of the slip plane underground. The epicentral zone, also called the "epicentral" or "epifocal tract," is thus elliptical area on the surface whose major

axis is parallel to the direction of the line joining the two focii underground.

(3) An "Isoscist," "Isoseismal" or "Isoseismal line" is a closed elliptical curve round the epicentral tract along which the intensities of the earthquake wave are the same. These curves are drawn on an ordinary map after carefully studying the effects of the earthquake. The usual practice is to number them from I to X in accordance with the intensity of the shock, its duration and damage done by it (Ref. Maps of Bihar, etc.).

(4) The "Mezoseismic line" is the isoseismal line along which the greatest destruction is done by the earthquake, and is some distance away from the epicentral tract. This maximum destruction is produced by the combined effect of (*a*) distortional waves from the center, (*b*) surface undulations from the epicenter, (*c*) waves once or twice deflected by the homogeneous ultra basic layer of molten magma at great depths below the origin, (*d*) the acceleration of the earth particles stressing the rocks past, the elastic limit and (*e*) the tilting movements produced by the tremors coming up at the critical angle of emergence.

(5) The "angle of emergence" of the earthquake wave is measured from the vertical, and varies in the cases of different earthquakes. It is found that the cracks produced in buildings in any particular locality show the same inclination to the vertical, and the angle of emergence may be determined by measuring the obliquity of these cracks.

(6) A "seismometer" is an instrument devised to record earthquake movements. The principal is that of a very heavy weight suspended by a great length of fine wire, moving with a long period when disturbed. The point of support is attached by means of a delicate spring to a column sunk deep down to a bed rock. The movements of the otherwise stationary weight give the displacements in the horizontal plane and the spring at the point of support records the up and down vertical motions of the earth particles. In practice this clumsy pendulum is replaced by a small one with an equivalent differential motion. Very ingenious instruments have recently been invented in Italy and Japan for measuring earthquake movements, recording the exact time of the shock and the distance of the earthquake origin from the instrument.

(7) "Seismograms" are graphic records obtained from seismometers and it may be noted that a tremulous horizontal line indicates normal conditions. The record is divided into three parts. The disturbance A B is produced by the preliminary tremors. Its length is constant and depends upon the distance of the earthquake origin from the instrument. Then come the major movements of the shock, which cause sudden and violent displacements of the pen up and down on the horizontal line. After the main shock, comes a second, a third or a series of shocks at constant intervals each equal to the first recorded distance A B. Sometimes there is a complete break in the record. The after shocks continue to arrive for a long time, perhaps for several months until the internal stress is relieved and conditions return to normal.

(8) "*Seaquake*"—Where the origin and epifocal tract are submarine, earthquakes occur under the sea. The bottom of the sea is disturbed and a sea wave is produced which, travelling in from the deep open oceans to the shallower water near the margins of the land may assume formidable proportions and cause great destruction far inland. It is noticed that the sea first recedes and then advances on the land with front. In many cases destruction has begun with an earthquake and a huge wave been completed by a sea wave.

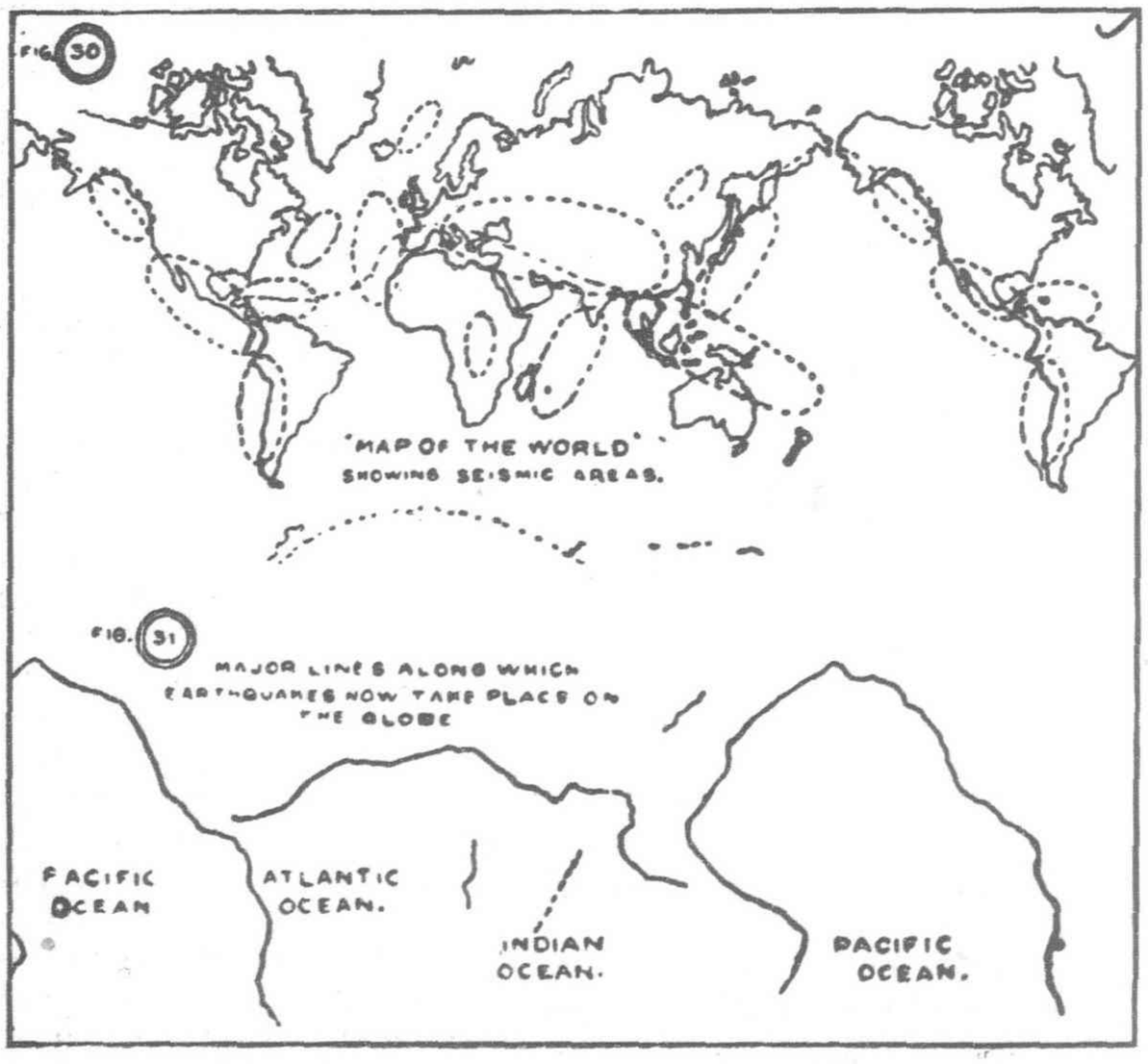
(9) "Seismic areas" or "Seismic zones" are those where earthquakes frequently occur. Therefore definite areas on the globe where these phenomena occur are most common. The two most important are, firstly, one beginning from New Zealand and the Australasian Islands and going around the Pacific Ocean along the eastern margin of Asia, through Japan, the Behring Straits, and the high mountains on the western coasts of North and South America, and secondly, one starting in the India Archipelago Islands which follows the meridional and latitudinal flexures of Eurasia through Burma, the Himalayas, Caucasus, Alps, and Carpathian Mountains, Portugal and thence across the Atlantic to the West Indies. There are also minor centers, one in the heart of Africa, a second in Mongolia and China and a third across the Arabian Sea and Indian Ocean. I may mention that earthquakes also take place in the vicinity of big volcanoes, but these seem to be of a different type. They do not affect large areas although they produce very great destruction in the volcanic area.

It will be noticed that seismic zones are more or less coincident with the steeper flexures of the earth's surface, and this points to their intimate connection with rock folding or tectonic movements and mountain building forces.

Although an earthquake may not originate in a particular area, an earthquake wave can pass through it; as a matter of fact in a very big earthquake the whole planet is shaken. Damage to life and property is, however, greatest in the mezoseismal zone, which is limited to a certain distance round the epicentral tract. Regions outside a seismic zone may, therefore, be considered as comparatively safe.

How are Earthquakes Produced

We have seen that earthquakes are caused by the molecular movements of earth particles set in vibration by condensational, transversal and undulatory waves produced by sudden displacements of rocks deep down in the earth's crust. Earthquakes, as a matter of fact, are very frequent, and although the ordinary



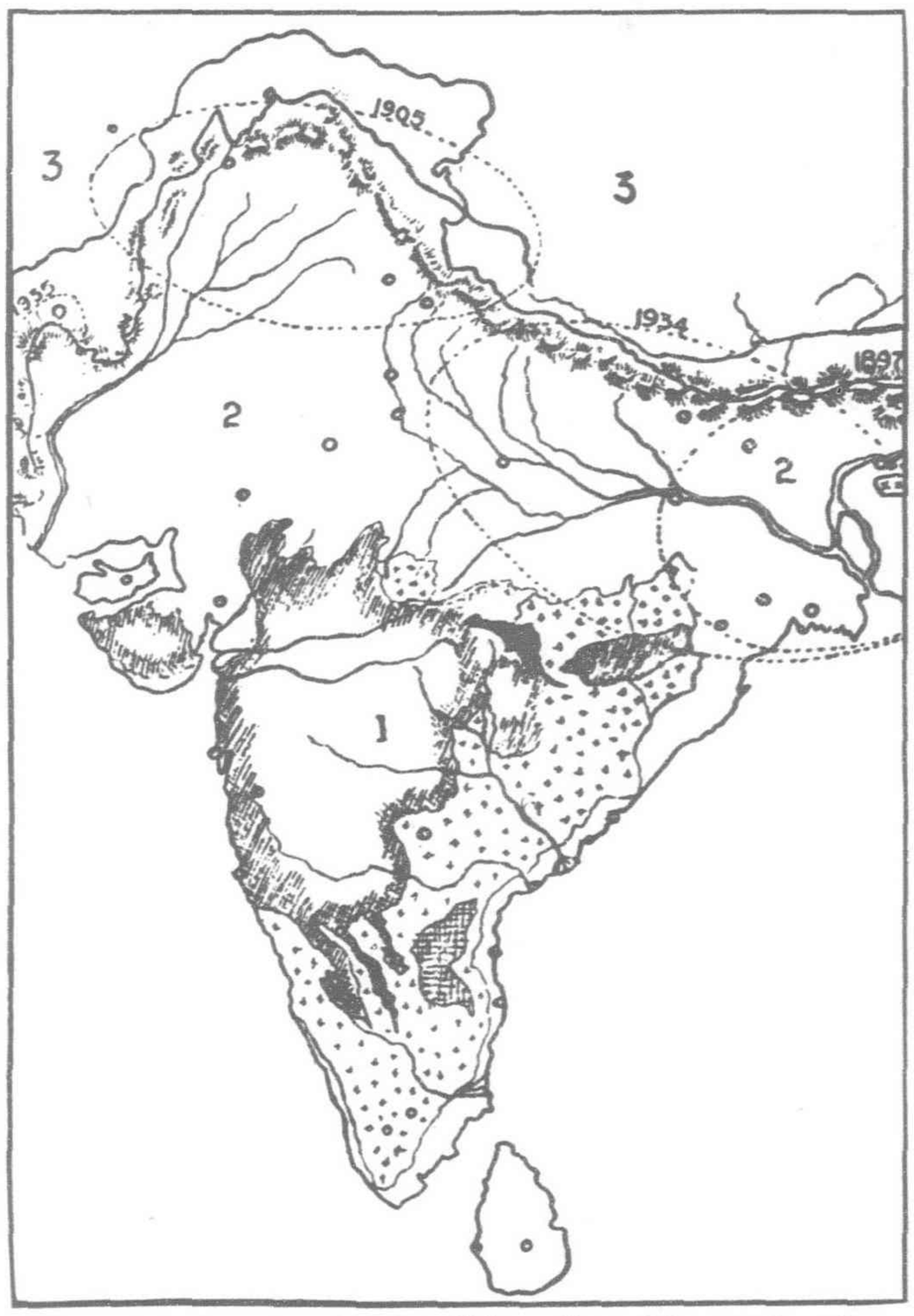
The diagram incorporates the major lines along which earthquakes now take place on the Globe

A section across Asia, showing earth flextures

man is only aware of them when they cause havoc and destruction, the crust is being actually shaken every half hour by minor shocks due to superficial adjustments. These, needless to say, do not produce earthquake waves like those of Bihar and Quetta, as for such waves colossal disturbances must take place at great depths in the earth. In general, the cause of earthquake may be enumerated as follows :—(1) rock folding, (2) fall of rock in supposed cavities in the interior of the globe, (3) migration of the polar axis, (4) readjustments of the centers of gravity of different parts of the earth, (5) subterranean explosions of steam, (6) radio activity of internal rocks, (7) passage of heat from the interior to the surface, (8) tidal forces, (9) reactions of the fluid pyrosphere, (10) volcanic phenomena, (11) gravitational pull of the Sun, Moon, planets and other heavenly bodies, (12) stresses and strains produced in the equatorial belt by the diurnal rotation of the earth round its axis, and (13) rock masses slipping down or being forced up along definite fault planes.

A casual examination of a rocky surface will show that the earth's crust is crossed and recrossed by fault planes in all directions. Displacements of rocks along major fault planes must have produced an earthquake wave in every case. These are (1) normal, (2) reverse, (3) strike, (4) dip or transversal, (5) oblique, (6) simple, (7) compound, (8) step, and (9) trough faults. Sometimes the rock displacements are so great that open fissures are produced and remain to be subsequently filled by gangue minerals and ores. In this connection it is interesting to note that the Quetta earthquake is reported to have produced a fissure-like depression running for several miles across country, and a similar happening occurred in the Bihar earthquake area as far distant as Jhansi.

In general, rock flexures are first produced and the rocks are then subjected to folding movements. When the stresses increase sudden fractures occur, particularly near the anticlinal apices, and there is a sudden slip along an old or new fault plane and earthquake tremors are left. It is found that a slip along a strike fault produces a simple type of earthquake, while when the movements take place along a dip fault tremors appear to originate at two underground focii, the distance between the foci being equal to that between successive crests and troughs of folds. The after shocks from such "twin" earthquake start from one of the two foci and are hence simple in nature. Body displacements of strata along a great length of oblique and dip faults give a very complex and highly destructive type of earthquake. The Bihar earthquake was of this type and the Quetta one may also belong to this category.



Map of India, showing localities affected by earthquake waves in :

Assam (1897) **Kangra (1905)**
Bihar (1934) **Quetta (1935)**

Short Descriptions of the Bihar and Quetta Earthquakes

The Bihar earthquake occurred at 2.13 p.m. on Monday, January 15, 1934. The area had previously been visited by earthquakes in the years, 1819, 1826, 1833, 1843 and 1869, but things had settled down after the last earthquake and it had been all but forgotten.

Suddenly, at 2.14 p.m., a terrific thundering subterranean noise was heard and a violent shock lasting five minutes was felt throughout the whole area affected. The greatest damage was done in a belt of 80 by 20 miles, but the shock was felt as far off as Lhasa, and in Calcutta the three seismometers at the Observatory were wrecked. There were two stages in the movements, with a lull between them, most of the damage being done in the second phase. Surface undulations could be distinctly seen, these being waves of six inches in height and about 12 feet in wave length, and fissures, 40 to 50 feet deep were caused, these being opened and closed alternately as the undulations passed. Human beings and animals were caught and imprisoned in these fissures and were in some cases ejected as the waves passed. Level ground on the banks of rivers sank bodily as much as 10 feet, and there were many landslides. Geysers of sand and water spouted up often to a height of six feet, and conical mounds of sand, with crater-like openings, dotted the whole country side and wells were also filled by intruded sand almost to the brim. The ejected water formed numerous shallow lakes while in many other cases the rivers and streams became dry and their beds were filled with sand. River banks approached one another and along the Ganges it was noticed that the water first piled up against the south bank and then receded. The sand and water spouts ceased after half an hour, leaving a whole countryside covered with sand and entirely ruined. Luckily there were only two towns in the epicentral tract and only a few fires occurred. As the shock arrived in the day time loss of life was fortunately not great, but there was widespread and complete destruction of property, including railway embankments, roads and, needless to say, buildings.

The Quetta earthquake, on the other hand, occurred at 3.02 a.m. on Friday, May 31, 1935. At about 3.00 a.m. a loud noise like that of the passing of a train through a tunnel was heard and immediately afterwards the violence of the main shock was felt. This first shock lasted three seconds. A second shock was felt at 5.00 a.m. and then a third one at 2.00 p.m. After shocks are being felt even now and they will continue for a few months until conditions settle underground and things return to normal. The zone of the greatest destruction passed through Quetta, town of more than 125,000 inhabitants, and the loss of life in Quetta alone must have been about 60,000 apart from that caused in Kalat and Mastang and the other towns and several villages between these and Quetta which were also destroyed. This earthquake was felt over an area of 300,000 square miles. Although the area affected was not as big as that in the case of Bihar (1,900,000 square miles—1934), Assam (1,750,000 square miles—1897) and Kangra (1,625,000 square miles—1905) and the shock lasted only a short time, the earthquake was an intense one and was evidently produced by complex type movements at a shallow depth. There was another shock of considerable intensity on June 2, 1935, which destroyed the Speizand railway; but the Chaman line and the Fort Sandeman area were not greatly affected. Not a single building was left standing in Quetta after the first shock and only the Staff College and Army Lines at a distance of six miles escaped with slight damage. The Quetta valley is 5,500 feet above sea level and the surrounding hills are 14,000 feet high. Portions of these hills cracked and clouds of dust were seen rising from them. This phenomenon was also seen for many days at Lucy Pass, 20 miles away from Quetta, and also on Takat Hill, 10 miles distant. The soil at Quetta differs materially from the Bihar alluvium. The former is not waterlogged and no reports of sand and water spouts have been received. A long fissure, marked by a subsidence of the ground to have been formed for a distance of over 80 miles during this earthquake. For the seismic map and other details we must wait until this locality has been visited by experts and carefully studied.

We may note that Baluchistan earthquakes are always of a very severe type. The three: (1) near Chaman (1892), (2) in the plains of Sibi, (3) down the Bolan Pass 40 miles east of Quetta (August 25, 1931), were all severe. There are in Baluchistan always more reflected and reflected waves causing damage and destruction, besides the main and after shocks.

Both the Bihar and Quetta areas are in the heart of seismic zones and it is interesting to see how the great mountain building forces operating in the extra peninsular area of India have produced these seismic zones to the north-east and north-west.

The Seismic Zones of the Indian Empire and Their Origins

For the purpose of our examination, India may be divided into three divisions: (1) Peninsular, (2) Indo-Gangetic alluvial plain and (3) Extra peninsular inclusive of Burma, the Himalayas, the North-West Frontier Province and Baluchistan. Of these (3) may be considered as seismic zones. The periodicity of the earthquakes there and their past history merit close observation and a careful study.

The peninsular area, from the Vindhyas to the south, consists of the oldest crystalline igneous rocks. It is a stable land with a easterly slope, while the Indo-Gangetic plains are dead level country with sand to a depth of thousand of feet. The extra peninsular area has been produced entirely out of a wide marine one, the tectonic movements having produced formidable mountains all round. The first longitudinal thrusts came from the north and north-east and after the anticlinal crests appeared above water and formed the Himalayan Mountain systems, the eastern and northwestern forces came into play and land rose everywhere in the extra peninsular area forming the present continental block linking the peninsular plateau to the newly made northern continent of Eurasia. The earthquakes both in the extra peninsular and the Indo-Gangetic alluvial areas are due to these tectonic movements.

The Himalayas themselves constitute a huge system of anticlines, the lofty mountains being the anticline and the alluvial area in front to the south a filled up syncline. The plains are therefore a region of under burden and the frequent gravity adjustments cause earthquakes. The Himalayas have a very great boundary reverse fault running all along from the W.N.W. to E.S.E. at the foot on the Indian side. The longitudinal and transverse sketch sections show this very clearly.

The original cause of the Indian earthquakes is thus seen to be the rise of an ancient sedimentary bed which once accumulated on the floor of the now obliterated ocean of central Asia. Movements are still going on and will not cease for æons to come. We have to study the periodicity of these movements and by a careful examination of the flexures in formation try to predict them and be prepared for them when they do arrive. Both things are possible.

The question of the prediction of an earthquake will be dealt with later. We shall now examine the manner in which engineering structures are affected and how we may make them earthquake-proof.

Effects of Earthquakes on Engineering Structures

The effects produced in the Bihar earthquake have been carefully studied. The observations were as follows:—

1. *Buildings:*
   - (*a*) Brick and masonry buildings with heavy roofs suffered without exception.

The Quetta earthquake in 1935

- (*b*) Columns supporting heavy roofs buckled and turned through a definite angle.
- (*c*) Buildings with unsymmetrical loading were destroyed.
- (*d*) Semi-circular arches collapsed.
- (*e*) Slanting roofs were thrown down and the lower walls thrust outwards.
- (*f*) Porches and porticos were invariably destroyed.
- (*g*) Cracks on walls started from the corners of doors and window openings.
- (*h*) Upper storeys were more damaged than lower storeys.
- (*i*) Buildings with their length in the same directions as that of the waves were badly fractured.
- (*j*) Unreinforced junctions of roofs and floors showed innumerable cracks.
- (*k*) Parapets fell.
- (*l*) Tiles and terraces on wooden beams suffered severely.
- (*m*) Buildings on the corners of streets suffered the most.

On the other hand promising features noted were as follows:—

- (*a*) Wooden huts and mud huts escaped undamaged.
- (*b*) Low compact buildings having less window and door openings did not suffer.
- (*c*) Light stiff roofs saved many buildings.
- (*d*) Buildings on firm rock were less damaged than those on alluvial ground.
- (*e*) Reinforced cement concrete buildings were found in good condition.

2. *Bridges:*
   - (*a*) Masonry piers were tilted and fractured.
   - (*b*) Girders were displaced longitudinally and fell from the piers.
   - (*c*) Girders on roller and sliding bearings rocked but remained in place in many cases.

Railways:

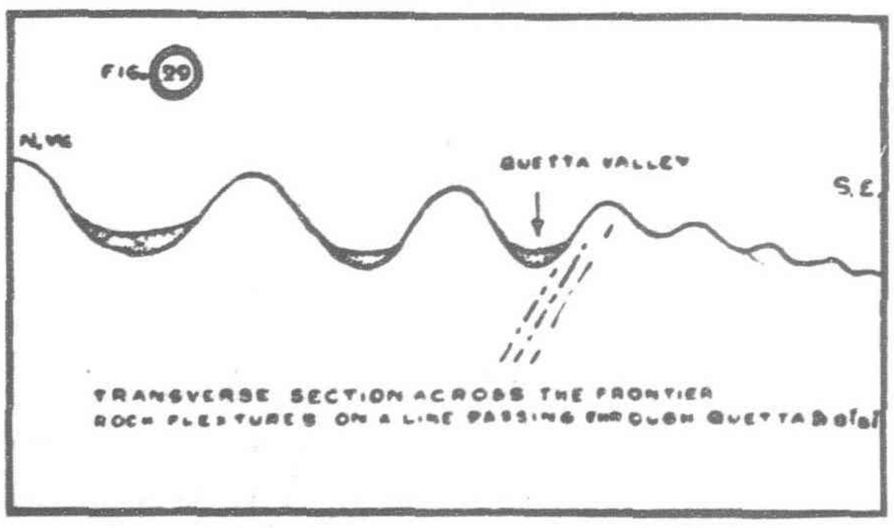
- (*a*) Rails were buckled and twisted completely out of shape.
- (*b*) Embankments were breached or subsided and often moved bodily.

General:

- (*a*) Wells became choked with sand and collapsed.
- (*b*) Water and gas pipes, sewage channels and surface drains were broken.
- (*c*) Telegraph posts and trees were uprooted.
- (*d*) Roads were cut up by fissures and holed by sand and water jets.
- (*e*) Fences were moved horizontally

In all cases, as might have been expected, defective design, poor materials and bad workmanship led to a speedy collapse where buildings of sounder construction were only partially damaged.

Town planning deserves the first place in these considerations. Sites for towns and their extensions in seismic zones should be very carefully chosen. The level of underground water should not be too near the surface, as swampy ground is liable to floods, particularly in the slump belt of the epicentral tract. Towns should not be located between a river valley and a mountain range, nor should existing towns be extended towards the river. The direction of chocks for a particular locality should be carefully studied and this will be found to be more or less constant. For example, in the United Provinces, Bihar and Bengal, the old practice was to build houses on sites



The direction of the Quetta Valley earthquake in 1935

slanting towards North and East. We now find that earthquake shocks travel there on the surface in those directions. Rocky sites are better than alluvial ones, this being clearly demonstrated at Monghyr. Narrow lanes with high buildings on either side should be avoided and all thoroughfares should be wide. Buildings should have sufficient courtyards and compound spaces (greater than the height of the building) and particular attention should be paid to the design and construction of buildings at the corners of streets. Open ground should be left for the congregation of men and animals in cases of disaster, in the directions from which the shocks come, e.g.. the westerly direction in Bihar. More exits from buildings should be provided which should be free from porches and overhanging balconies.

Foundations should be deep, as deep foundations minimize the movement of the superstructure. They are particularly advantageous in the case of low buildings. In alluvial ground a good foundation is a R. C. block or R. C. raft with a few inches of sand filling all round and underneath. This would transmit the shock as one unit.

Too many door and window openings, long verandahs and unsymmetrical openings should be avoided. Tops of windows and lintels should be at one level and continuous and semi-circular arches should be avoided as far as possible and if present, should be reinforced.

In the construction of high buildings corners should be in cement, reinforced with cranked bars, and it is better to use cement masonry at the junctions of walls and corners. Cornices and long unsupported walls should be provided with buttresses. Vertical cracks caused by undulatory and disortitional movements can be avoided by the use of R. C. band courses at the door and roof levels.

A steel framed superstructure is the best for an earthquake area while brick in cement also gives good results. The upper storey should be as light as possible, and preferably of wooden or ferro-concrete construction. Diagonal stressing plays a very important part in earthquake shocks, and the lighter and more flexible the roof the better it stands. Top reinforcements are necessary even for floors and these must be designed for upward thrust also. The structure, in short, should be rigid, as a rigid structure moves with the same period as that of the ground and comes to rest quickly, while a non-rigid structure attains its own period and may have the top amplitude as much as two or three times the base one. It is therefore advisable to use elastic columns in the lower storey, which will enable the structure to oscillate 1-in. or 2-in. without the internal stresses exceeding the elastic limit. The building, incidentally, should never be top heavy and it must have a very short period of vibration.

A steel framed structure with rigid connections between its horizontal and vertical members and walls, with wall partitions and floors of reinforced concrete, is found to be the best.

The probable acceleration should be determined for a particular locality. This can be done by carefully studying the effects of past earthquakes, and I would suggest that the Public Works Department ought to prepare elaborate maps of isoseists in seismic areas. The acceleration may be worked out by considering :—(1) the over-turning of walls, pillars and monuments, (2) the distance to which superstructures are thrown and (3) by seismographs.

To reiterate, structures in seismic areas must be of suitable materials, well designed and properly built. They should have a square or rectangular plan with their length in the prevailing direction of shocks, and they should have continuous well spread foundations of suitable materials such as cement and reinforced concrete. Diagonal bracings damp vibrations and render structures resistant to collapse by reducing the period and shortening the amplitude and these should, therefore, be provided in all cases. Solid rock or compact soil should be preferred as a foundation, edges of earth basin should be avoided, and single storeyed buildings should be the limit.

The question of water supply should be very carefully studied as wells usually choke up after an earthquake. Water and light have to be restored almost immediately and to preserve these it is important that all cables and mains should be carried underground.

I am of the opinion that earthquakes in seismic areas can be foretold with as much precision or want of precision as is attained in forecasts of weather. Serious earthquakes fortunately only visit us at long intervals; but when they do come they cause immense loss to life and property. By being prepared beforehand engineers would be able to face them better. About two years ago an earthquake shook the station at Mach near Quetta and the jail and other buildings there were destroyed. It is surprising that this question then was so lightly dismissed and people there remained unaware of the impending danger. That was the first thing that occurred to me when I visited Quetta in 1933.

Looking into the question of the leaks of the tiny water reservoir near Quetta, I knew that even a passing quake would readily open up the already loose partings in the rocks which are very steeply inclined at the place. Only a structure properly designed to withstand tremors could stand there and in my opinion ferro concrete construction with proper orientation was necessary. The question was uppermost in my mind (the time then being just after the great Bihar earthquake) when we were discussing a paper on "The water supply in Baluchistan" last year, and I referred instinctively to the possibilities of an earthquake in that neighborhood.

The history of past earthquakes needs careful study and there should be many more seismographic-stations in the Indo-Gangetic alluvial area, Sind, Baluchistan and Burma. An ideal arrangement in India would be an engineering geologist, in touch with the International Seismographic Society, working in close co-operation with the Public Works Department and reporting to a Committee of Engineers, Geologists and Seismographists. For the predictions of earthquakes distant station observations are more suitable. Stations in Japan and Europe can get a better idea of stresses and strains developing underground under the Himalayas, Baluchistan and Burma hills than the observatories situated in those localities themselves. I would suggest that a qualified engineering seismologist or a geologist should, therefore, be asked to visit these foreign observatories and go into the question very thoroughly.

The constitution of the interior of the earth should be more carefully studied and I suggest that etherical waves (similar to those used in wireless) should be utilized in the study of the internal stresses and strains in the earth's crust.

Another line of research would be the behavior of deep sands when subjected to wave motions similar to those produced in earthquakes. The question of sand and water spouts, fissures, slips, displacements, etc., in such areas may then be properly solved. The tilting of the valley throwing the waters of the river Ganges to the south side first gives a clue to the nature of the sand wave produced there. The whole alluvial area is rising very slightly in ripples from Benares to Calcutta and the Himalayas are still rising and so are the Baluchistan and Burma ranges. The Himalayas are bound to involve the whole of the alluvial areas between them and the Vindhyas in a grand succession of folds and earthquakes will therefore be periodic. I hope engineers all over the country will now take up this question seriously, try to be forewarned by studying seismology and build structures which may shake but not come down.

Improvement of Peiping-Hankow Railway

To facilitate transportation on the line, 20 new locomotives have been ordered from abroad by the Peiping-Hankow Railway Administration. Meanwhile, the equipment of the railway workshops will be increased. Large quantities of repair materials, new motors, boilers and sundry machines will be bought.

The traffic system on the line will be improved. The long-distance telephone line between Hankow and Chengchow have already been extended to Peiping. More shunts are being built at various stations to facilitate the dispatch of trains and engines.

Where the distance between two stations is too great, sub-stations are now being built in between so as to facilitate traffic. Many of the stations which are in a tottering state will be re-built and walls or fences will be built around the stations to prevent trespassing. The signalling system will also be improved to ensure safety and speed of traffic.

The total debts of the line, up till 1933, amounted to $91,000,-000. Since 1934, payment by instalments has been effected in accordance with instructions issued by the Ministry of Railways, and this will be continued until all debts are paid up.

The railway authorities are confident that with the realization of the seven-year plan the Peiping-Hankow Railway will be a model railway in the country.

The Gold Mining Industry in Manchoukuo

MY. 200,000,000 Output Expected in Next Five Years

THE gold mining industry in Manchoukuo has made remarkable progress, having for its dynamic center the Manchuria Gold Mining Co., which is incorporated under a special charter from the Manchoukuo Government. In the meanwhile, the surrounding situation, too, has undergone a considerable change.

To adjust itself to the altered status, the Company has mapped out a five years' program of its own, starting with the current year, 1937.

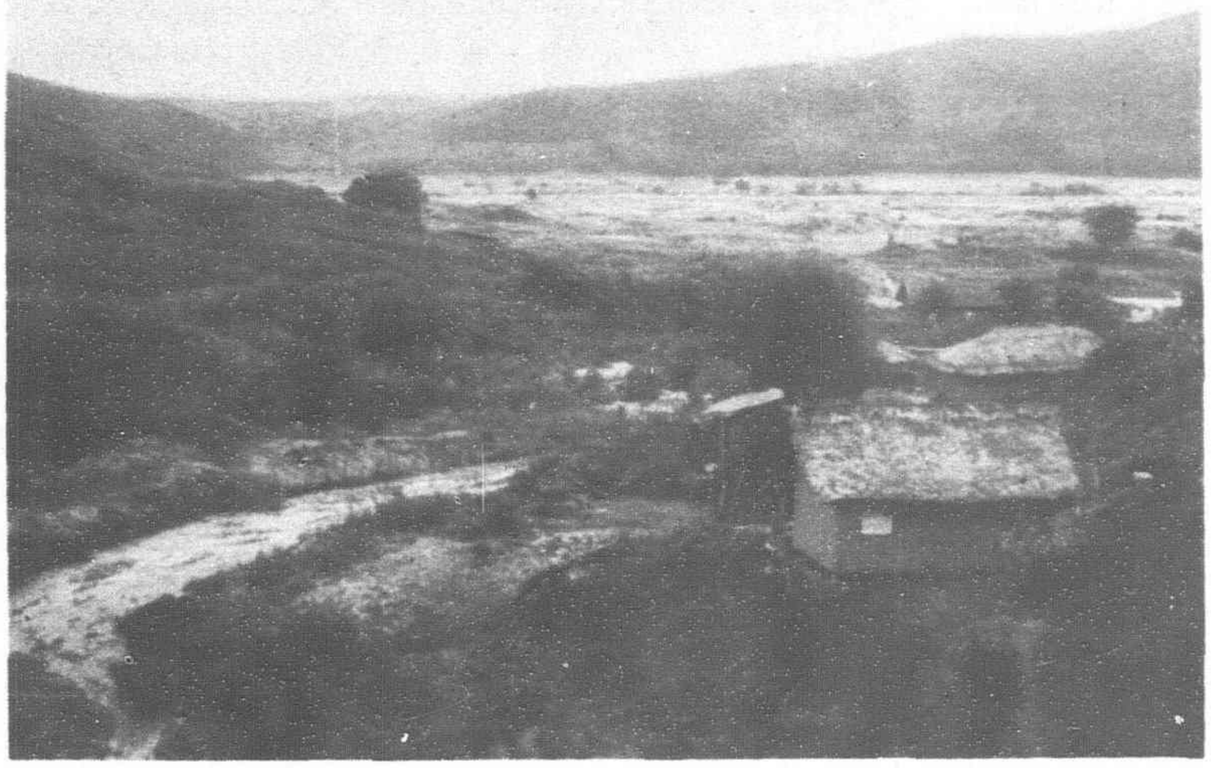
The young State of Manchoukuo, barely five years old, has been enabled, through the strenuous endeavors of both officials and people, united solidly, to complete the laying of her national foundations, and is now entering upon her positive construction task.

The fast pace at which she has developed politically, economically and financially has evoked the wonder of the outside world as without a parallel in history and is due to the adoption of appropriate national policies based upon contracted economy.

The gold mining industry has been placed under State control from the beginning because of its special character, and, by acting discreetly when occasion demanded, with a view to fostering its healthy advance, the efforts put forth have brought an ample reward in a short span of time.

Talking of gold output, such only as were gathered at the hands of the Company and also the parties bound to the Company by contract started, in 1934, with M.Y.357,000 worth and increased more than tenfold up to M.Y.3,670,000 in the following year 1935. Last year, in 1936, up to November, the total returns ran up to M.Y.9,000,000, and might have climbed to M.Y.10,000,000 or above before the year was out.

If such a pace is kept up, it will not be long before the annual total in all Manchoukuo soars to M.Y.100,000,000.



Peichatzu gold-field panorama, the center of placer gold mining in the Chientao Area

As already stated, such handsome results were due fundamentally to controlled economy, but for its direct causes, may be counted the businesslike exploitation of the mines since they were begun, the taking over of such mines as the Government invested in, and the introduction of State control over their operations, technical and financial aid rendered the parties, contract-bound, for prospecting experiments and mining work; and technical and managerial information given such parties for guidance and help.

Over and above all the most outstanding factor consists in the almost marvellous luck that has favored quite a few of the mines under the Company's direct management.

Manual Mining

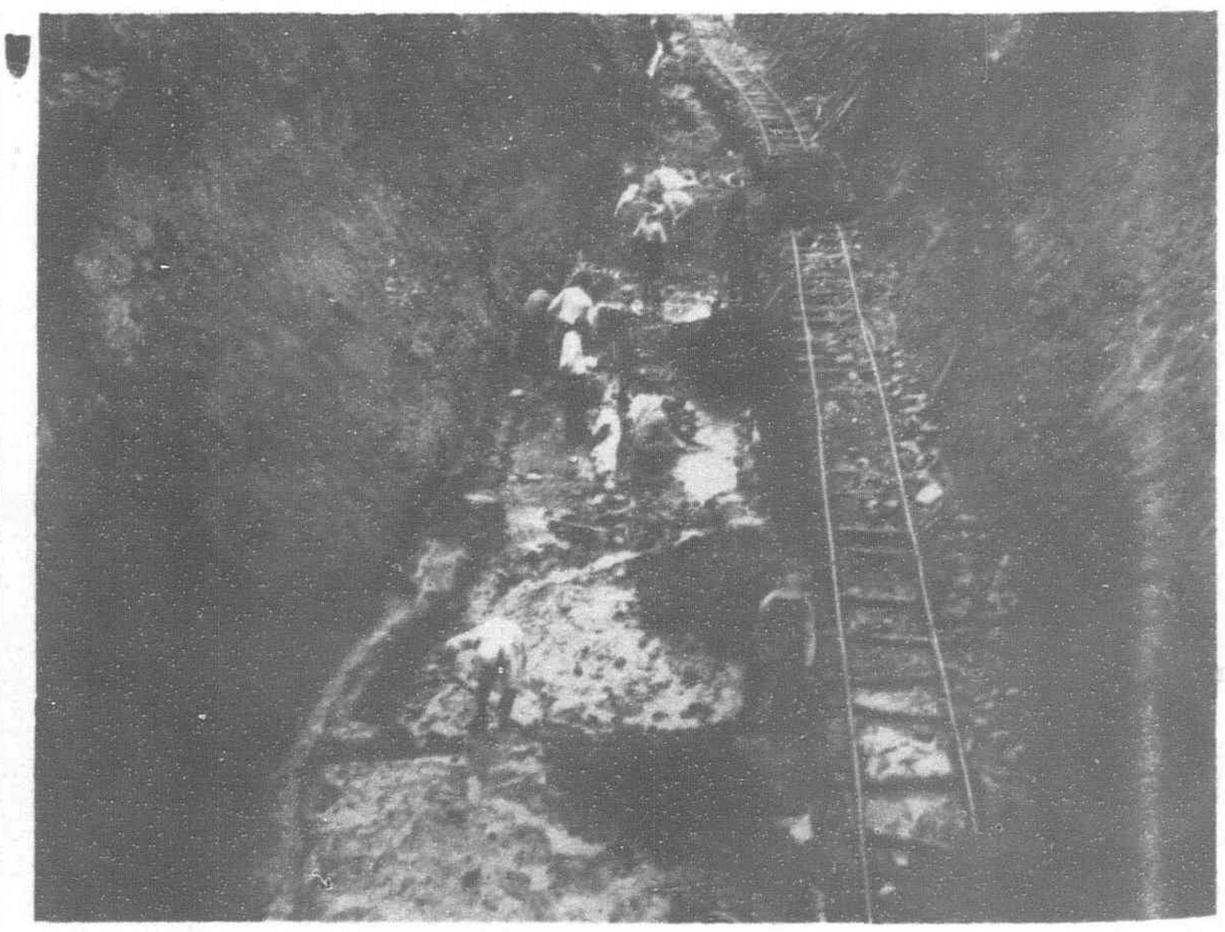
The most wonderful is the magic expansion of the mining town of Hsiaoshihtou situated south of Chiamussu, the capital of Sankiang Province, on the Sungari.

This particular mine near the town mentioned is worked by hand and employs some 7,000 workers. The daily march of this big army of mining coolies from the town to the mine in the morning and back again to their quarters after the day is over is indeed a sight worth seeing.

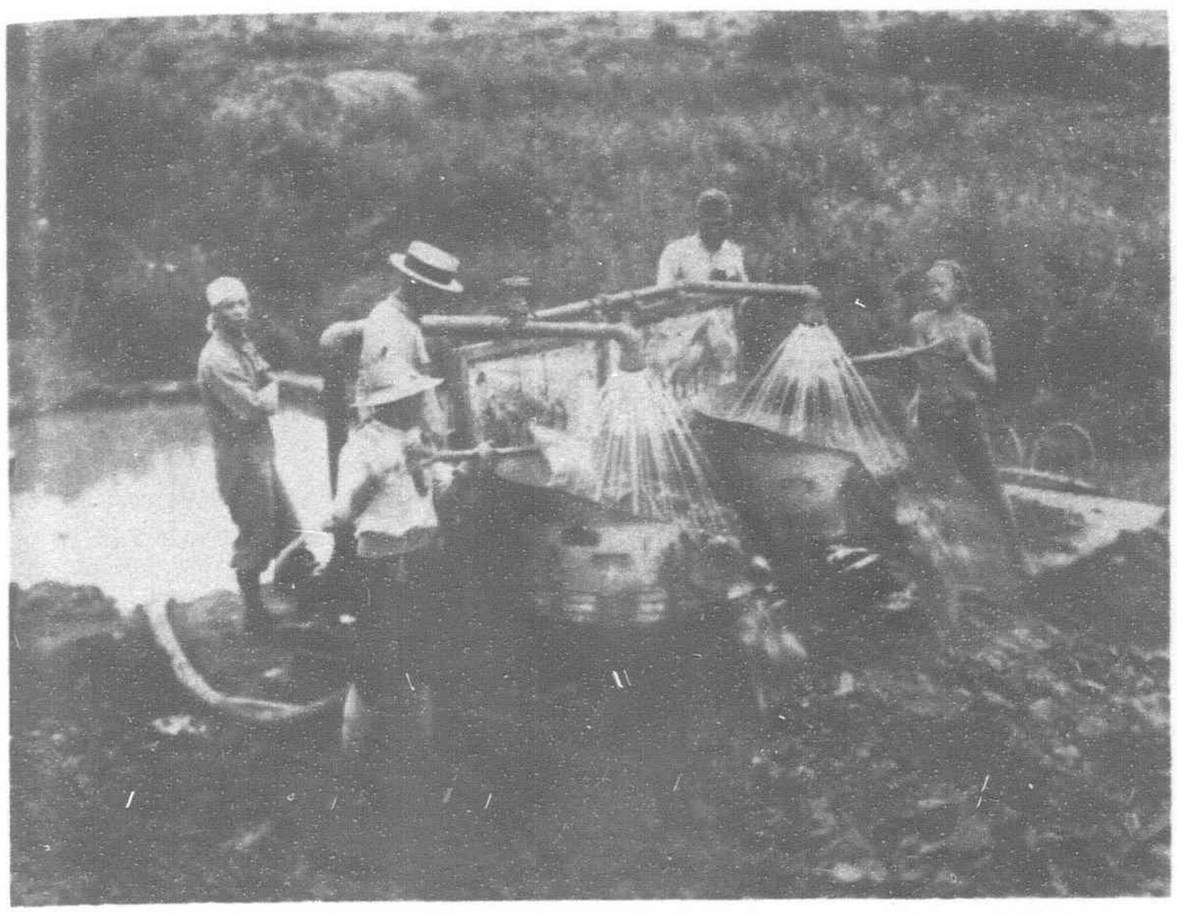
This town is a miniature Klondike. It was a mere hamlet of a dozen farm huts or so prior to the Company's advent there on locating the mine. The encouraging mining returns realized by the Company have kept attracting mining coolies and it has now grown into a decent-sized town of 15,000 people with all kinds of amusement resorts for the coolies. It promises a steady growth and a cheery future.

Between January and November, 1936, the gold production of this mine reached M.Y.3,000,000, that is, one-third of the aggregate total for that period. From August of the same year, the monthly returns mounted to M.Y.400,000 to 500,000.

Boring soil to test gold content the first stage of placer-mining



Second stage of placer-mining



Another set of machines is used for the second washing

Hill-tops above Peichatzu, the gold-mining center

The discovery of new mines is expected to make the prospect look still brighter.

Placer Mining

Second, placer mining is carried on in the Nichu River, about 75 miles southwest of Heiho on the Amur, opposite Blagovestchensk. This stream, in its upper reaches, runs among the Minor Hsingan Range and admits of mining operation by dredger. The building of a dredger was commenced in spring last year and finished by October, and it was pressed into service at once with flattering results.

One of the dredger's buckets has a capacity of 5 cubic feet. It is equipped with an engine of 500 h.p. and is capable of dredging 120,000 cubic yards per month.

This gold dredger is, by the way, regarded as a model of efficiency, showing how to work placer mining in Manchoukuo. The Company is now planning to build a few more dredgers.

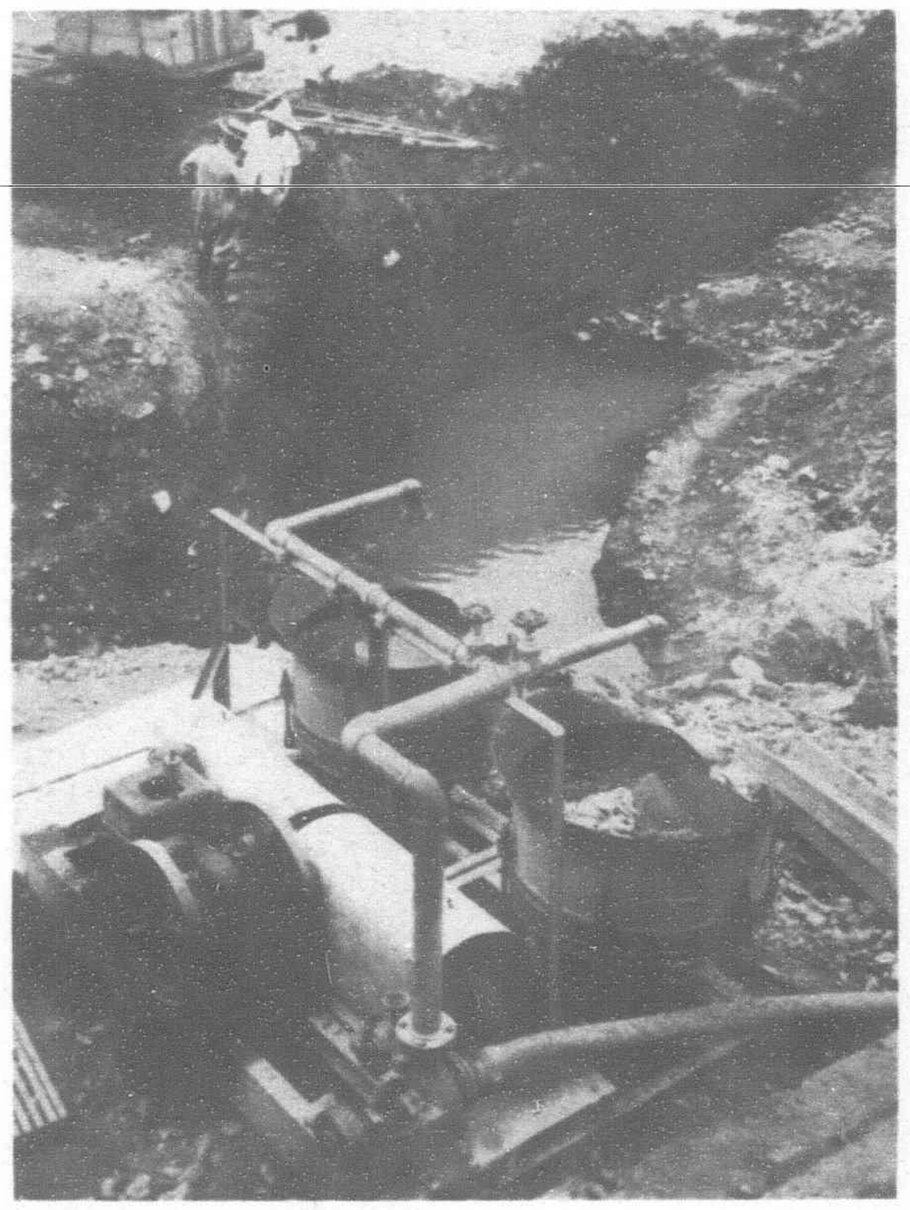
The dredger in question is of the same structural type as an ordinary dredger, only, it is installed with sand-scooping equipment. The dimensions are indicated by the sand-scooping capacity of one of its buckets.

The biggest one, the building of which is under project, is of 15 cubic ft. It is 45 meters long, 18 meters in width, and 19.5 meters in height. It is to weigh 2,000 tons and will be driven by an engine of 1,200 h.p. Its dredging capacity is to be 400,000 cubic yards per month. Its crew consists of only 29 men to work in three shifts daily, and their working efficiency is equal to that of 7,000 mining coolies put together!

Alluvial Gold

Third, alluvial gold is found over an extensive area around Tumentzu, 67 miles north of Hunchun in Chientao Province, near the Korean and Siberian littoral.

Unlike its kind elsewhere, for gold deposits on a hilltop, dearth of water for ashing the deposits has to be contended with, and a dam is to be constructed on a neighboring height, a few hundred feet higher, so that the water of the dam may be conducted to the required spot to let it fall right upon it with a head of 200-300-ft. The hydraulic pressure is to be utilized for mining purposes, and preliminary preparations are now under way.



Modern gold-separation machinery is replacing the former primitive "Gold-Pan"

This will be the first mining method of the kind to be adopted in Japan, Chosen and Manchoukuo, and once it gets into working order, the gold yields in that region are expected to increase rapidly.

In addition, promising alluvial gold mines are being discovered in the Huma River valley to the north of Heiho on the Amur, the Amur River valley also running into the mighty Amur, and situated south of Moho farther up the big river, Tangyuan Prefecture opposite Chiamussu across the Sungari, the valley of the Mutankiang River which empties itself into the Sungari near Sansing, and Huatien Prefecture lying south of Kirin and east of Ssupingkai.

As regards reef gold mines, those located near Kaishantun on the Korean border and at Chinglin not far from Mutankiang, now the rising junction town where the Harbin-Suifenho Line (formerly the Chinese Eastern Railway, Eastern Section) and the new Tumen-Chiamussu Line intersect have already undergone preliminary technical surveys, and preparations are being pushed forward for working them.

On the data already noted, the outlook of the gold mining industry in Manchoukuo has become ascertained as commercially feasible, whilst the gold mining company itself has felt its own foundations as quite consolidated. Just at this juncture, the Manchoukuo Government having drafted a plan for industrial development extending over five years, the Company, too, as a corporation under a special charter, has entered into the spirit of the scheme, and, in chalking out a five years' mining program of its own, has roughly figured out the total yield from the current year to 1941 at M.Y.200,000,000, allocated to the respective intervening years as follows: 1937 M.Y.14,800,000, 1938 M.Y.22,000,000, 1939 M.Y.36,000,000, 1940 M.Y.55,000,000, 1941 M.Y.82,000,000. Granting the realization of this program, the above estimate concerns the Company's working areas only under direct management and indirect control.

If all gold production in Manchoukuo at the hands of other parties should find its way into the State treasury, as it ought to, and further, if enterprising capitalists in Manchuria and Japan should be induced to invest in this industry, it might not be so long ahead as we might casually think before the total gold reserve of the State treasury, Hsinking, ascends to between M.Y.400,000,000 and 500,000,000.

Specie Reserve

The urgent necessity for replenishing the State's specie reserve with the least possible delay by developing gold mining needs no reiteration.

A glance cast over how Japan and Manchoukuo stand singly and internationally will still emphasize this burning necessity. For, the rapid replenishment of the specie reserve is indispensable for keeping the financial status of Manchoukuo from the inflation that is dreaded from expanded finances forced upon the country, in terms of the treaty signed with Japan for joint national defence, for carrying out the five years' industrial program, and because of the necessary increase of administrative expenditure in consequence of Japan's withdrawal of extraterritoriality, and also the immense funds required by Japan for settling a large army of farming immigrants in Manchuria.

Then, the enhancement of the national prestige of both Japan and Manchoukuo must be kept in constant view.

To build up the foundation of the State's finances on a solid ground by replenishing the specie reserve means a surer guaranty of the nation's strategic security and the increase of her fighting power, both of which will go a long way to head off possible war.

This might be considered as the very core of the continental diplomacy of the two fraternal nations and the key-stone for preserving peace in the Far East.

Now reverting to tangible measures as to how to carry through the Company's five years' scheme, there are several under proposition. The foremost is to extend prospecting all over the country, and to make it thoroughgoing.

This being the basic condition on which depends the success of the industry, efforts should be focused on this point.

Heretofore, M.Y.500,000 to 600,000 has been laid out annually for prospecting purposes, but a gradual increase in the sum being contemplated, M.Y.1,000,000 is set aside for the current year, to be raised year after year,up to, say, M.Y.2,000,000 to M.Y.2,500,760.

The matter of the most direct and important interest in augmenting gold production lies in expanding mining operations. With this object in view, first, about a dozen or more new gold dredgers are to be constructed during the period of the increased production program. To begin with, during 1937, a new dredger will be built for the Nichu River ; two more, one of 15 cubic ft. and the other of 5 cubic ft. for Sankiang Province ; and two others, of 10 cubic ft., for the Heiho district. It might be added that building work has already been taken in hand.

As promising gold areas may be mentioned the Wolaken River, the Chona River, the Amur River, and the Baikalu Mountain in Heiho Province ; Kuantu, the Tulu River, and Wu-Hulin north of Mutankiang in Sankiang Province ; and the Huatien district in Kirin Province.

Technical investigation of the mineral wealth of these gold areas will be expedited, whilst the construction of new dredgers will also be executed with despatch.

There indeed remains much room for improving mining methods in vogue at present by introducing the latest machinery of divers sorts and by mechanizing mining operations in general.

By the technical improvement of operations the production cost may be lowered, besides enlarging the areas of operation, attended with increased production. The discovery of new mining areas, too, should be duly reckoned with.

For carrying out all these plans, M.Y.34,000,000 to 35,000,000 is estimated as needed, part of which sum is expected to be obtained by floating debentures.

International Review on Timber Utilization

Although wood ranks fourth in point of value in the list of the world's raw materials, up to but a short time ago its interests were observed only by a few organizations, which were inadequately developed and not particularly influential. There was a total lack of international contact and collaboration.

With the advent of the international economic crisis, this lack became more acutely felt and the League of Nations convened the first timber conference in 1932, from which, however, no concrete results were attained. Finally, after a series of fruitless conferences, the "Comite International du Bois" was inaugurated in the autumn of 1932.

The "Comite International du Bois" is an international organization for the promotion of timber interests. Its official status is evidenced by the fact that most of its members are official bodies or national organizations enjoying official powers, or representatives of the whole of the private timber interests of the country concerned. Furthermore, the Committee is officially recognized by the League of Nations as an international organization.

The increasing interest in China for the improved employment of timber should warrant an early participation of Chinese delegates in the conferences of the International Timber Committee stimulating research and technique for timber.

About a month ago or so the Central Government equipped a motor-caravan of 20 busses for a good-will tour to the southern province of Yunnan. One of these buses was an experimental one using charcoal and vegetable oil made in China. Of paramount interest for the Chinese authorities was the result of this trip; the charcoal bus using no more than $98 worth of charcoal and other material while the ordinary buses had a bill of $250 each for oil fuel. The trip from Nanking to Kunming in Yunnan and back covered a distance of approximately 6,000 kilometers, which fact evidently shows the suitability of charcoal buses for rural trips in China.

The Far Eastern Review has just received a copy of the latest number of the *International Review of Timber Utilization*, a journal appearing at intervals of six to eight weeks in English, French and German, published as official organ of the department of International Timber Utilization of the "Comite International du Bois."

This journal deals in a manner comprehensible to all with every problem affecting the various branches of timber utilization and embodies a series of interesting reports from all over the world. The contents are not only of great interest for the timberman as such, but is worthy of the attention of every technician concerned with timber. The news is furnished by trade correspondents in almost every country in the world.

"Austral-Asiatic Bulletin" Appears

The first number of the new publication, *The Austral-Asiatic Bulletin*, numbering 24 pages, contains interesting phases of contemporary world affairs, including feature articles of scientific, literary and domestic interest. Among them is to be found "What China Is To-day," by Mr. Edwin Haward, Editor of the *North-China Daily News*, who, backed by years of residence as a journalistic observer in China contributed a very valuable piece work to this inaugural issue. Other contributions, all by competent writers, include "Australia and Imperial Defence," by Mr. E. L. Piesse, former Director of Intelligence to the Department of Defence, during the late part of the World War ; "Some Aspects of Japanese Colonization," by Mr. Ian Clunies Ross ; "Immigration from Asia," by Professor Ernest Scott and many others.

Among the special features in this first issue of *The Austral-Asiatic Bulletin* is an article on the Japan-Australia trade dispute, contributed by Mr. C. A. S. Hawker, member of the House of Representatives for Wakefield and formerly Minister for Commerce. This article is reprinted elsewhere in this issue. The author recently visited Japan.

A foreword sets forth that *The Austral-Asiatic Bulletin*, concerned as it is to review and comment upon current opinion regarding the Orient, does not espouse the easy solution of international problems—that of finding a scapegoat and assigning him to the wilderness. It is committed to the wider but less easy task of ascertaining the facts and summing up the evidence.

"The Australian Institute of International Affairs, the Victorian Branch of which publishes *The Austral-Asiatic Bulletin*, is forbidden by its Constitution to pass judgment, but unless discussion is to become unreal and de-vitalized, complete freedom must be granted to informal personal opinion. Only thus can Australia become better acquainted with and more curious about the Orient, of which she is part. Only thus can the neighbor nations understand her better."

Power Generation and Transmission in Japan

*By SHIGEMI SHIMOGAICHI, Engineer of the Bureau of Electric Power, Ministry of Communications, Tokyo, in "The Electrotechnical Journal" **

After briefly explaining the remarkable progress of electric power generation and transmission made in the last half century in Japan, the author points out some principal features as follows : There is abundant water-power available at sites not very far from load centers, therefore Japan adopts the fundamental policy of " water-power first and steam-power second." Although she lacks fuel resources, she has a number of large modern steam-power stations for the purpose of supplying just enough power to meet requirements in the effective utilization of water-power resources. The majority of water-power sites are located in the central part of the main island, and they are within economical transmission distance from two important cities, Tokyo and Osaka. Many main transmission lines at 154,000-volts have already been constructed for these water-power sites, and in addition a certain number of steam-power plants of large capacity have also been installed in the vicinities of these cities.

The recently proposed plan of the Government for the control of electric-power generation and transmission is outlined. Some prominent hydro-electric and steam-power stations in this country are described, and the outstanding features of these plants are discussed.

JAPAN is a narrow country consisting of several islands. She has abundant water-power resources very nearly all over the country, but she lacks fuel resources such as coal and oil—only a small amount of coal being mined in Hokkaido and Kyushu. Therefore, Japan utilizes more water-power as compared with steam-power.

It was as early as in November, 1889, when a tiny steam-power plant was built in Tokyo, in the heart of the city, for the public supply of electric light. This was the first power plant ever built

**The Electrotechnical Journal* is the new Overseas Monthly published by The Institute of Electrical Engineers of Japan.

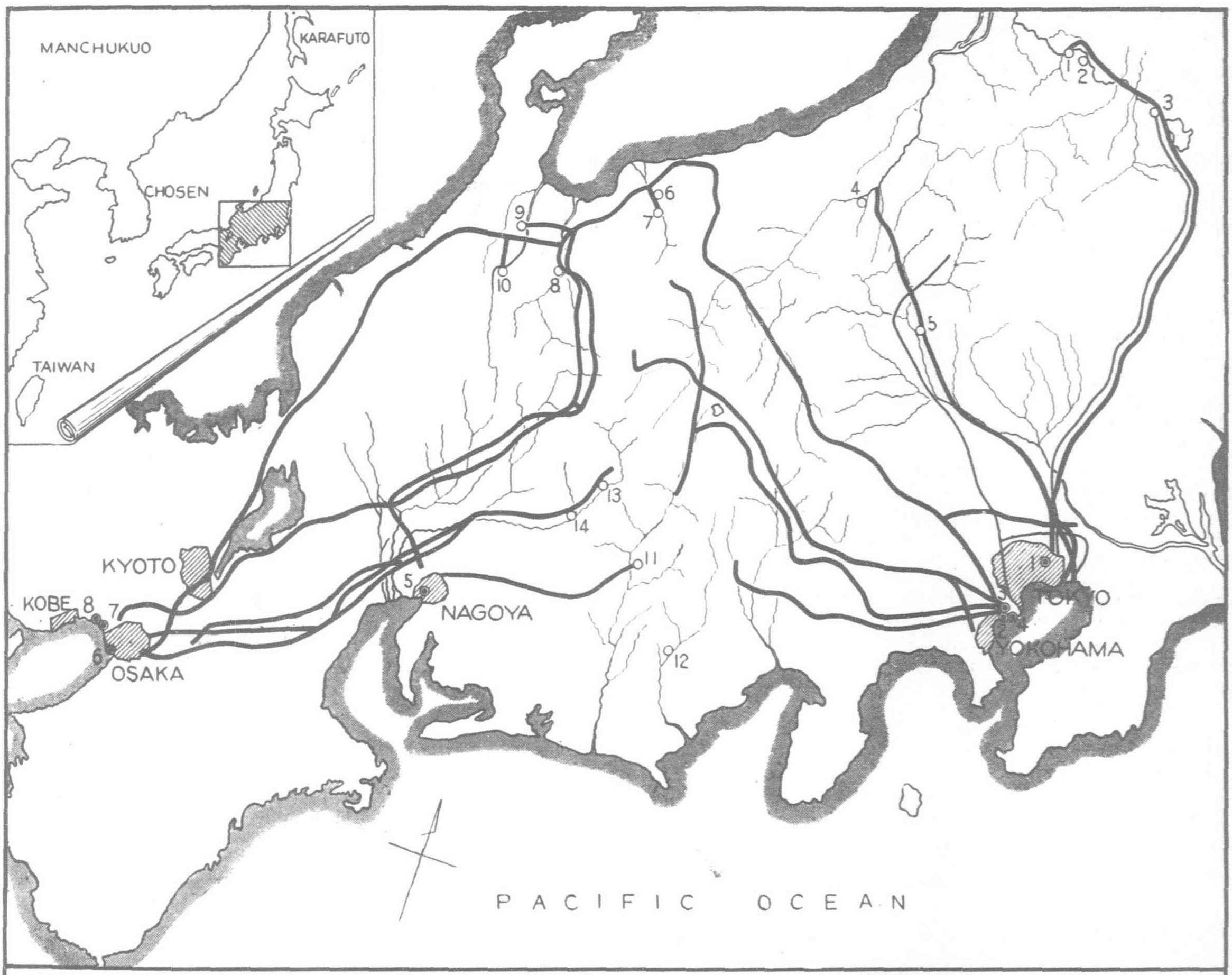


Fig. 8. A Map Showing 110,000-V and 154,000-V Transmission Lines in the Middle Part of the Main Island

154,000-volt line
110,000-volt line
○ Hydro-electric station
◉ Steam-power station

Big Hydro-electric Power Station

1	Kanose	6	Yanagawara	11	Yasuoka
2	Toyomi	7	Kurobegawa No. 2	12	Ohigawa
3	Inawashiro No. 1	8	Kanidera	13	Yomikaki
4	Nakatsugawa No. 1	9	Komaki	14	Ohi
5	Saku	10	Soyama		

Big Steam-power Station

1	Senju	5	Nagoya
2	Tsurumi	6	Kitsugawa
3	Tokyo	7	Amagasaki
4	Kawasaki	8	Amagasaki

in Japan, followed by a hydro-electric-power plant which was installed near Kyoto in conjunction with the construction of Lake Biwa canal in 1892.

Since then, electrical enterprises were undertaken in every part of the country during the last half century. These enterprises, developing year after year, have contributed to make Japan the greatest industrial country in the Far East. Figure 1 shows the development of power generation in this country from 1903 up to the present. In earlier days steam-power generation exceeded hydro-electric-power generation in output; but in accordance with the progress of electrical enterprises, the construction of water-power plants has been undertaken, and from 1912 water-power plants predominated over steam-power plants, so that the principle of "water-power first and steam-power second" was gradually realized.

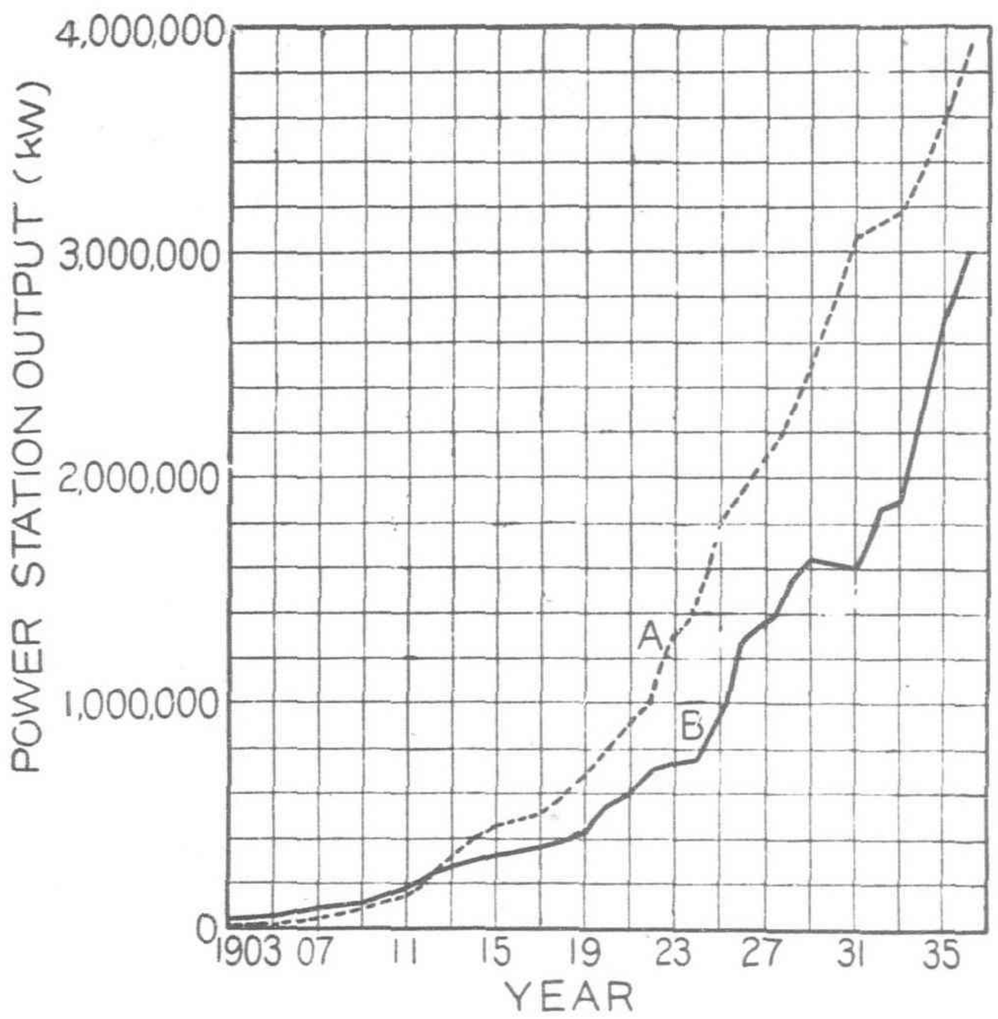


Fig. 1. Growth of Power Station Output

A: Hydroelectric power
B: Steam power

At the end of 1936, the net output of hydro-electric-power plants for electrical enterprises was 3,652,000 kw. and that of steam-power plants 2,142,000 kw. The total energy generated during the year 1936 (December 1935-November 1936) was estimated at about 24,200,000,000 kwh of which 19,640,000,000 kwh (81.2 per cent) was generated by water-power and 4,560,000,000 kwh (18.8 per cent) by steam-power.

Water-power Resources

The theoretical water-power (potential power based on effective head) is estimated as follows:

Minimum flow	5,136,000 kw.
Six-month flow	10,914,000 kw.

At the end of 1936 the theoretical water-power actually used reached 4,840,000 kw.

Mountain ranges run nearly all over the country, but the important ones lie in the middle part of the main island (*Honshu*), where start a number of rivers such as the Shinano-gawa, the Kurobe-gawa, the Kisogawa, the Tenryu-gawa, the Ohi-gawa, and the Tone-gawa, and these rivers pour into either the Pacific Ocean or the Japan Sea. Roughly 70 per cent of the total water-power is developed in this part of the country which is within distance of economical transmission to either Tokyo or Osaka, two of the largest load centers.

The quantity of flow of these rivers varies considerably in accordance with the seasons of a year. Roughly speaking, such months as May, June, September, and October are the seasons in which abundant water-power is available, while January, February, and August are the months in which water-power is not sufficient. According to the degree of availability of water flow, we employ the terms "six-month flow" or "three-month flow" besides "minimum flow." In general the six-month flow is 1.9 to 3.7 (average 2.4) times the minimum flow; the three-month flow is 2.7 to 4.9 (average 3.8) times the minimum flow.

Water flow utilized at power plants is, at present, not equivalent to the minimum flow of the stream, and is gradually raised year by year. Particularly from the viewpoint of effective utilization of water-power resources in recent years, a number of reservoirs and regulating ponds have been constructed on the one hand, and a number of steam-power stations have been installed to cover the deficiency of power at low-water season on the other hand, so as to facilitate the efficient utilization of the six-month or the three-month water flow. Figure 2 shows the yearly increase of reservoirs and regulating ponds. There are 16 reservoirs or regulating ponds having effective storage capacity of 1,000,000 cubic meters or more, whose total storage capacity is estimated at 530 million cubic meters.

Hydro-electric Power Plants

The number of hydro-electric power plants for electrical enterprises at the end of 1936 was 1,340. The total output was 3,650,000 kw., that is about 2,720 kw. per station. Among these there are 86 stations rated at 10,000 kw. or above, whose total output amounting to 2,030,000 kw., approximately 56 per cent of the grand total.

The majority of these big stations are located in the central part of the main island, and their generated power is transmitted to Tokyo, Nagoya, and Osaka. Table I gives the particulars of hydro-electric-power stations with an output of 50,000 kw. and over, of which some are explained below:

The biggest station is Komaki Station. Its capacity is 72,000 kw. Situated on the Sho-kawa, it has a huge reservoir with a high dam of 75 meters in height, the highest dam in Japan.

Large hydraulic turbine-generators, completed in the period of 1925 to 1935, were mostly made in Europe or America; but the machines installed in the last few years are exclusively of home make. For example, Kurobegawa No. 2, Ohigawa, Yasuoka, and Toyomi Stations (see Table I) are equipped with such machines.

TABLE I. HYDRO-ELECTRIC POWER STATIONS OF 50,000 KW. AND OVER

Power Station	*Company*	*River*	*Maximum Output (kw.)*	*Eff. Head (m)*	*Water Flow (m^3/s)*	*Capacity of Reservoir or Pondage (m^3)*	*Water Turbine*			*Generator*					
							Type	*Capacity (kw.)*	*Maker*	*Capacity (kva)*	*Voltage (kv)*	*Phase*	*Frequency*	*Unit*	*Maker*
Komaki	Shokawa Suiryoku Denki	Sho-kawa	72,000	70.3	139.0	18,200,000	Francis-Vertical Shaft	21,630	E.W. (2) I.P.M. (2)	20,000	11	3	60 50	4	G.E. (2) B.B.C. (2)
Kurobegawa No. 2	Nippon Denryoku	Kurobegawa	65,200	180.5	41.74	—		25,300	Dengyosha	26,500 24,000	11	3	60 50	3	Shibaura
Ohigawa	Ohigawa Denryoku	Ohi-gawa	62,200	123.0	65.1	835,000		23,500	,,	24,000	11	3	60 50	3	Shibaura
Saku	Kanto Suiryoku Denki	Tone-gawa	55,000	114.0	112.1	723,000		26,860	A. C.	28,000	11	3	50	3	W. H.
Toyomi	Toshin Denki	Agano-gawa	54,000	25.0	270.0	2,780,000		10,440	Hitachi	11,000	11	3	50	6	Hitachi
Yasuoka	Yahagi Suiryoku	Tenryu-gawa	52,500	36.0	178.1	4,040,000		16,000	Dengyosha	16,500	6.6	3	60 50	4	Shibaura
Yanagawara	Nippon Denryoku	Kurobe-gawa	50,700	123.0	48.7	—		20,500	E. W.	20,000	11	3	60 50	3	W. H.

Barrel-type generators are seen in Kurobegawa No. 2 and Saku Stations. The totally enclosed ventilation system is adopted in the former station. Each of these large stations has more or less specialities.

Toyomi and Kanose Stations on the Agano-gawa are known by their large quantity of water flow. They utilize 270 m^3/s at effective heads of 24.5 m and 22.4 m respectively.

Our typical high-head plants are Oguchigawa No. 3 (621.2 m), Hadeba (562 m), Magawa (532 m) Stations, etc. Oguchigawa No. 3 Station of the Nippon-kai Denki K.K. is, in addition, a hydraulic storage (pumping-up) power station. Its output is 14,000 kw., corresponding to the flow of 2.78 m^3/s. Besides two 8,950-kw. Pelton wheels and two 10,000-kva generators, this station is equipped with a pump (6-stage turbine pump) of the delivery of 0.39 m^3/s. The pump is directly coupled to a 3,580-kw. synchronous motor. Ikejiri-gawa Station of the Chuo Denki K.K. is another pumping-up power station. It utilizes the water of Lake Nojiri; its output is 2,340 kw. In this station, there are two pumps directly coupled to the main synchronous generators and a separate synchronous motor-pump unit. The capacity of each water turbine is 1,342 kw., each generator 1,500 kva, and the pumps driven by main motors are of the delivery of 1 m^3/s each, that driven by independent motor is of the delivery of 2.45 m^3/s, both at lift of 85 m.

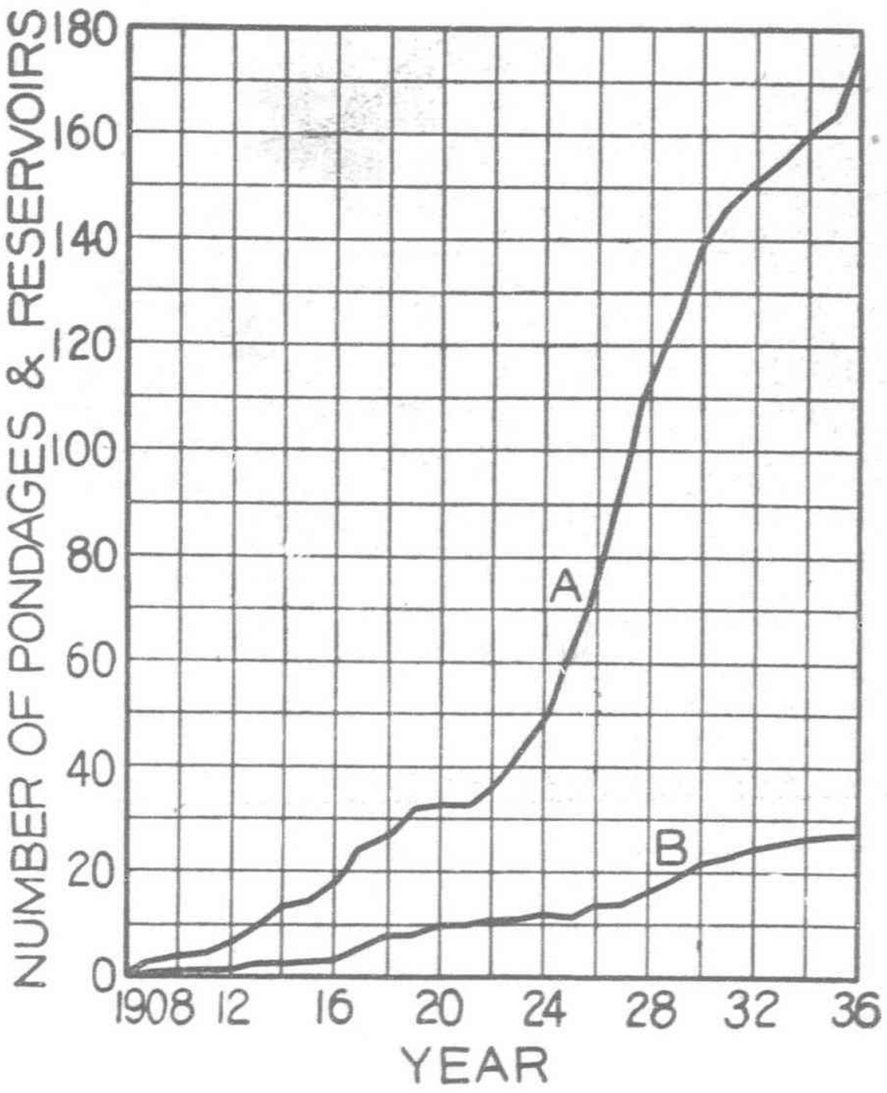


Fig. 2. Number of pondages and reservoirs
A: Pondages
B: Reservoirs

At the end of 1936, there were several water-power stations under construction, to meet the accelerating increase of power demand all over the country. Two stations, recently commenced on the Shinano-gawa, namely Shinanogawa Station of the Tokyo Dento K.K. and Senju Station of the Imperial Government Railways are, among others, the most important ones. The former is rated at 170,000 kw., while the latter at 120,000 kw. These are expected to be put in operation in 1939. The latter has for the first installation three 31,000-kva (37,000-kva for one-minute) generators. The waterwheels, rated at 44,700 kw., are already delivered from the Hitachi, Ltd. This is the biggest Francis turbine ever made in Japan, having a runner diameter of 3,736 mm. and a diameter of entrance of the casing of 4,500 mm.

In Japan there is about as much 60-cycle power as there is 50-cycle power, and as a whole the middle part of the main island where water-power is abundant, forms a ridge of flow of 50-cycle power east bound, 60-cycle power west bound. Consequently the hydro-electric-power stations in this region are required by the Government to be designed for operation at either cycle.

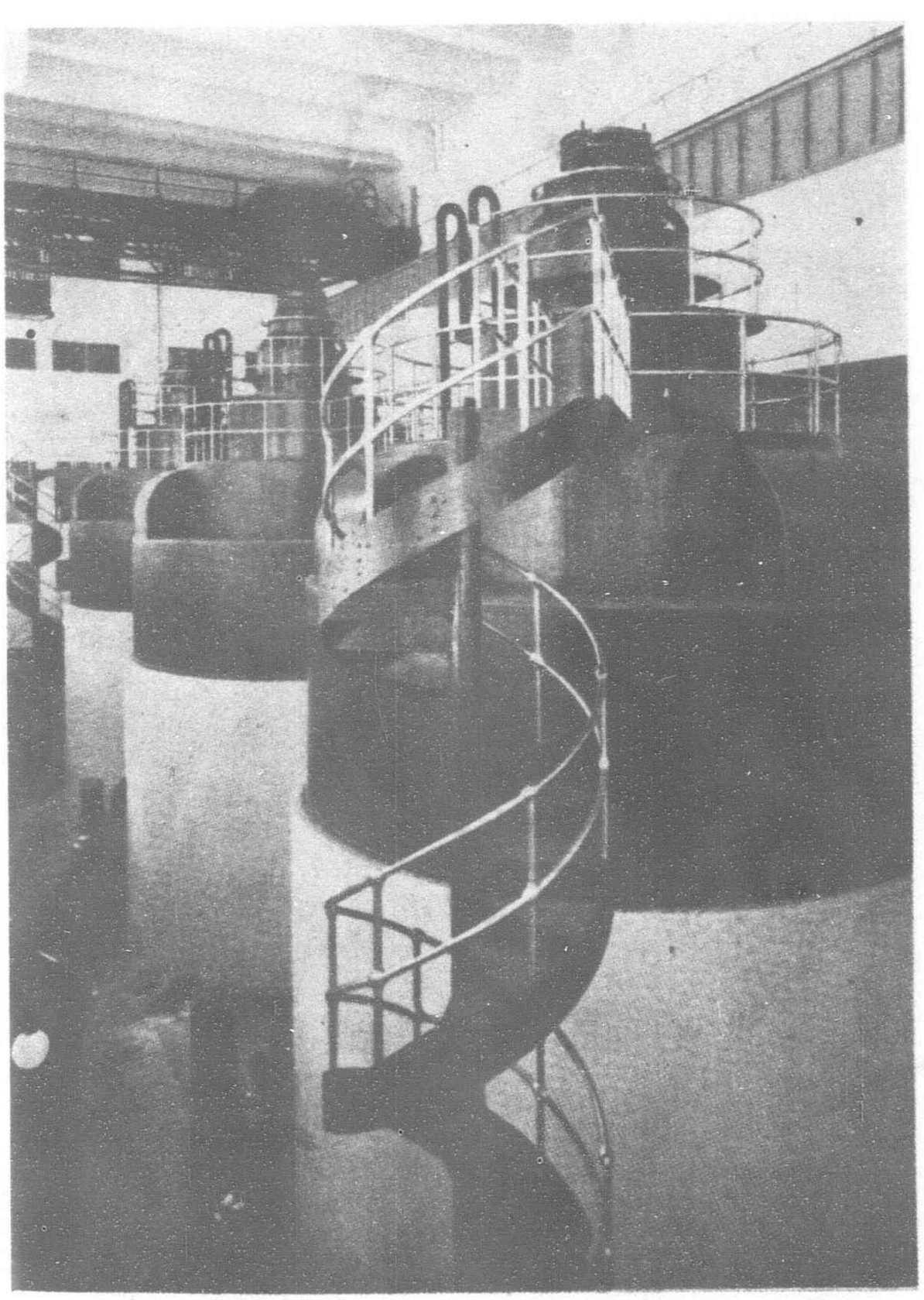


Fig. 3 (A). Kurobegawa No. 2 Station of Nippon Denryoku K.K. (maximum output 65,200 kw.)

Steam-power Plants

To utilize water-power most effectively, the joint operation with steam-power is of utmost importance, hence it is natural that the increase of hydro-electric power has brought the consequent increase of steam-power as shown in Figure 1. As in the U.S.A. and in Europe, the records of the steam pressure and the temperature are renewed each year as shown in Figure 4. Table II shows the latest record-making power plants in chronological order, and it gives a clear conception of the latest development.

At the end of 1936 there were 217 steam-power stations for electrical enterprises with a total output of 2,140,000 kw., or with the average output of 2,860 kw. per station. Of these, there were 49 stations with output of 10,000 kw. or above, amounting to the total output of 1,907,000 kw., or 89 per cent of the entire steam-power.

TABLE II. CHRONOLOGICAL RECORD OF IMPORTANT STEAM-POWER PLANTS

Year	*Company*	*Power Plant*	*Boiler*	
			Steam Pressure (kg/cm^2)	*Steam Temperature (°C)*
1924	Nippon Denryoku	Amagasaki	19.4	335
1925	Toho Denryoku	Nagoya	24.6	390
1927	Tokyo Dento	Tsurumi	26.4	399
1930	Oji Seishi	Kokura Mill	30.0	—
1931	Kyushu Denki Kido	Kokura	37.5	415
1932	Sanyo Chuo Suiden	Shikama No. 3	45.7	400
1932	Yamaguchi-ken	Shimonoseki-Maeda	38.7	443
1932	Mitsui Kozan	Ohura	52.5	438
1933	Kansai Kyodo Karyoku	Amagasaki	42.0	445
1936	Tokyo Dento	Tsurumi	45.0	450

Steam-power stations of large capacity for electrical enterprises are situated near the coast, inside the districts where large power is demanded, such as Tokyo-Yokohama district, Kyoto-Osaka-Kobe district, Nagoya district, and Northern Kyushu district. In Tokyo-Yokohama district, there are Tsurumi (178,500 kw.) and Senju (77,500 kw.) Stations of the Tokyo Dento K.K., Tokyo Station

(64,000 kw.) of the Nippon Denryoku K.K., Kawasaki Station (55,300 kw.) of the Imperial Government Railways; in Kyoto-Osaka-Kobe district, there are Amagasaki Station (318,000 kw.) of the Kansai Kyodokaryoku Hatsuden K.K., Amagasaki Station (140,000 kw.) of the Nippon Denryoku K.K., Kizugawa Station (63,000 kw.) of the Ujigawa Denki K.K.; in Nagoya district, there are Nagoya Station (109,000 kw.) of the Toho Denryoku K.K. and in Northern Kyushu district, Kokura (54,000 kw.) and Daimon (400,000 kw.) Stations of the Kyushu Denkikido K.K., Minato Station (87,000 kw.) of the Kyushu Kyodokaryoku Hatsuden K.K. On the coast of the Inland Sea, Shikama No. 3 Station (55,000 kw.) of the Sanyo Chuo Suiden K.K., Saka Station (48,200 kw.) of the Hiroshima Denki K.K. and Ube No. 2 Station (44,000 kw.) of the Yamaguchi Prefecture are important ones. Table III gives the general information about the important stations mentioned above.

Fig. 3 (B). Kanose Station of Toshin Denki K.K. (maximum output 49,500 kw.)

Amagasaki Station of the Kansai Kyodokaryoku Hatsuden K.K. is modern and the biggest steam-power station in our country; its total installed capacity is 318,000 kw. consisting of six 53,000 kw. turbine-generator units, of which five are home-made (see Figure 5). The same company is planning the second power station adjacent to the above station, which will finally be equipped with six 75,000 kw. machines. The first unit of the 75,000 kw. machine is under installation. This 75,000 kw. machine is also manufactured in Japan, which makes a record in our country. Tsurumi Station of the Tokyo Dento K.K., the second largest station, has the largest steam generating units. Each of the four boilers newly installed has the evaporating power of 175 tons of steam per hour at 45kg/cm² and 450°C. The 62,500-kva main generator is directly connected to a three-phase 63,000-kva, 10,500/69,000-v transformer.

The 26,200-kw. Mitsubishi turbine-generator, installed in 1935 at Saka Station of the Hiroshima Denki K.K. is interesting, because it was, for that time, the world's largest machine with 3,600 r.p.m. Thenceforth a number of such high-speed turbine-generators as 25,000 kw.–3,600 r.p.m., or 50,000 kw.–3,000 r.p.m. have been put on order to our manufacturers and some are already installed.

As to the adoption of extra-high pressure of steam, the Sanyo Chuo Suiden K.K. is planning to install a 10,000-kw. "top" turbine at Shikama No. 3 Station with a steam pressure of 130 kg/cm² and a back pressure of 42.4 kg/cm² (that of existing two 35,000-kw. units).

For the purpose of utilizing coal most economically, it is important to resort to the method of centralizing steam-power stations, that is, to operate a small number of possibly large and efficient stations rather than to employ medium or small ones at the disposition of each electrical enterprise. The Government, adopting this principle, sitmulated the establishment of power companies destined to build such superpower plants and to supply electricity to electric enterprises at reasonable rate. Such companies are called "Kyodo-Karyoku Hatsuden K.K." (consolidated thermal-power generating companies), and there exist at present four, *viz.* Kansai (at Osaka), Kyushu (at Omuta, Kyushu), Seibu (at Tobata, Kyushu) and Chubu (at Nagoya), of which the two former opened business several years ago.

Steam-power stations in Japan, except those in Kyushu and Chugoku districts, are generally operated as auxiliary stations for the low-water season of hydro-electric stations or as peak-load stations. Nevertheless, due to the remarkable progress of the generating equipment as well as the rationalization of the plant operation, the coal consumption per kwh generated is decreasing year after year. Figure 6 shows the tendency of decrease of the coal consumption of the chief steam-power stations for electrical enterprises in our country.

TABLE III. BIG STEAM-POWER STATIONS

Power Station	Company	Capacity Installed (kw.)	Date Opening	Boiler: Maker	Steam Press. (kg/cm²)	Heating Surface (m²)	Unit	Combustion	Superheater Temp. (°C)	Turbine: Maker	Type	Capacity (kw.)	Unit	Main Generator: Maker	Capacity (kva)	Voltage (kv)	Unit
Amagasaki	Kansai Kyodo Karyoku	318,000	1933-1936	Mitsubishi	42.0	1,665	6	Pulverized coal	445	Mitsubishi Ishikawajima	2-cylinder tandem-compound	53,000	3	Mitsubishi	62,500	13.2	3
				B & W	42.0	2,090	6			,, ,,	,, ,, ,,	53,000	2	Shibaura	62,500	13.2	2
										M. V.	,, ,, ,,	53,000	1	M. V.	62,500	13.2	1
Tsurumi	Tokyo Dento	178,500	1927	B & W	26.4	1,728	4	Chain-grate stoker	399	G. E.	Single cylinder	35,000	2	G. E.	43,750	11.0	2
			1935	B & W	26.4	1,670	2	,, ,,	400								
			1936	B & W	45.0	960	4	Pulverized coal	450	Mitsubishi	2-cylinder tandem-compound	53,000	1	Mitsubishi	62,500	11.0	1
										A. E. G.	,, ,, ,,	53,000	1	A. E. G.	62,500	11.0	1
Amagasaki	Nippon Denryoku	140,000	1924	B & W	19.35	1,005	4	Under-feed stoker	334	M. V.	Single cylinder	26,000	2	M. V.	25,000	11.0	2
							4	Pulverized coal									
			1927	B & W	20.4	1,250	4	Chain-grate stoker		E. W.	,, ,,	25,000	2	S. S. W.	25,000	11.0	2
			1928	B & W	20.4	1,343	4	Pulverized coal	338	M. V.	Tandem-compound	40,000	1	M. V.	43,750	11.0	1
Nagoya	Toho Denryoku	109,000	1925-1926	B & W	24.6	1,728	4	Chain-grate stoker	390	G. E.	Single cylinder	35,000	2	G. E.	43,750	11.0	2
			1935-1936	B & W	24.6	1,670	4	,, ,,	390	A. E. G.	2-cylinder tandem-compound	35,000	1	A. E. G.	43,750	11.0	1

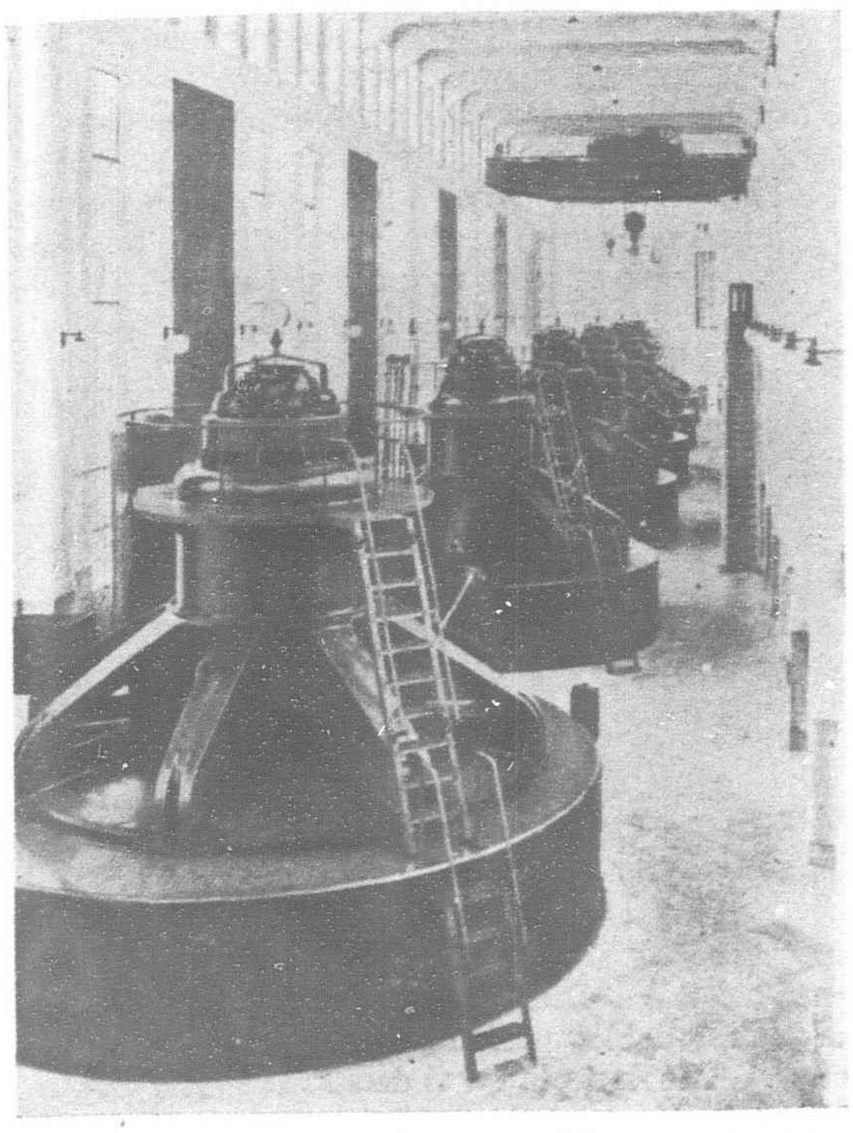


Fig. 3 (C). Toyomi Station of Toshin Denki K.K. (maximum output 54,000 kw.)

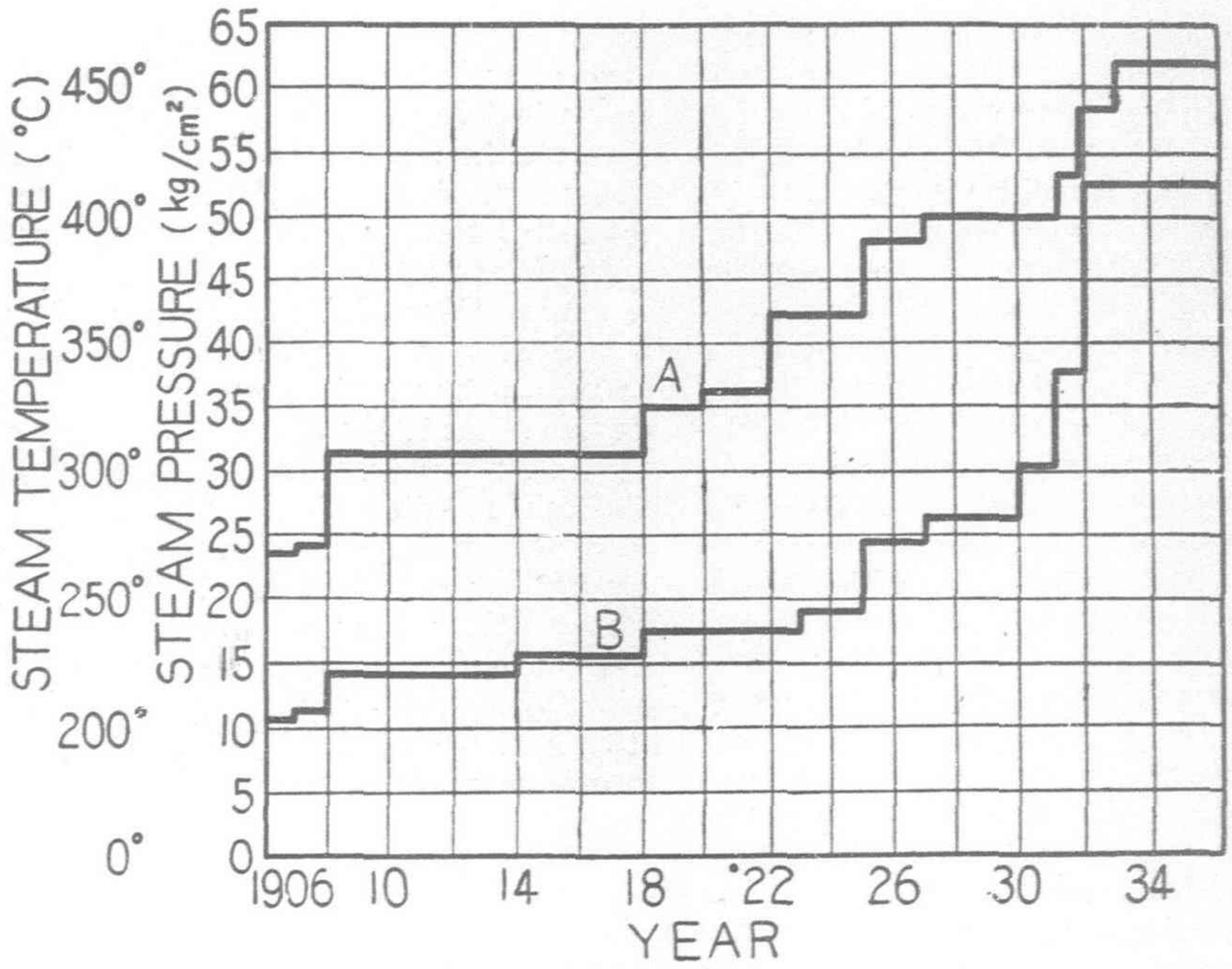


Fig. 4. Rising Tendency of Steam Pressure and Temperature of Steam-Power Plants

A : Steam temperature
B : Steam pressure

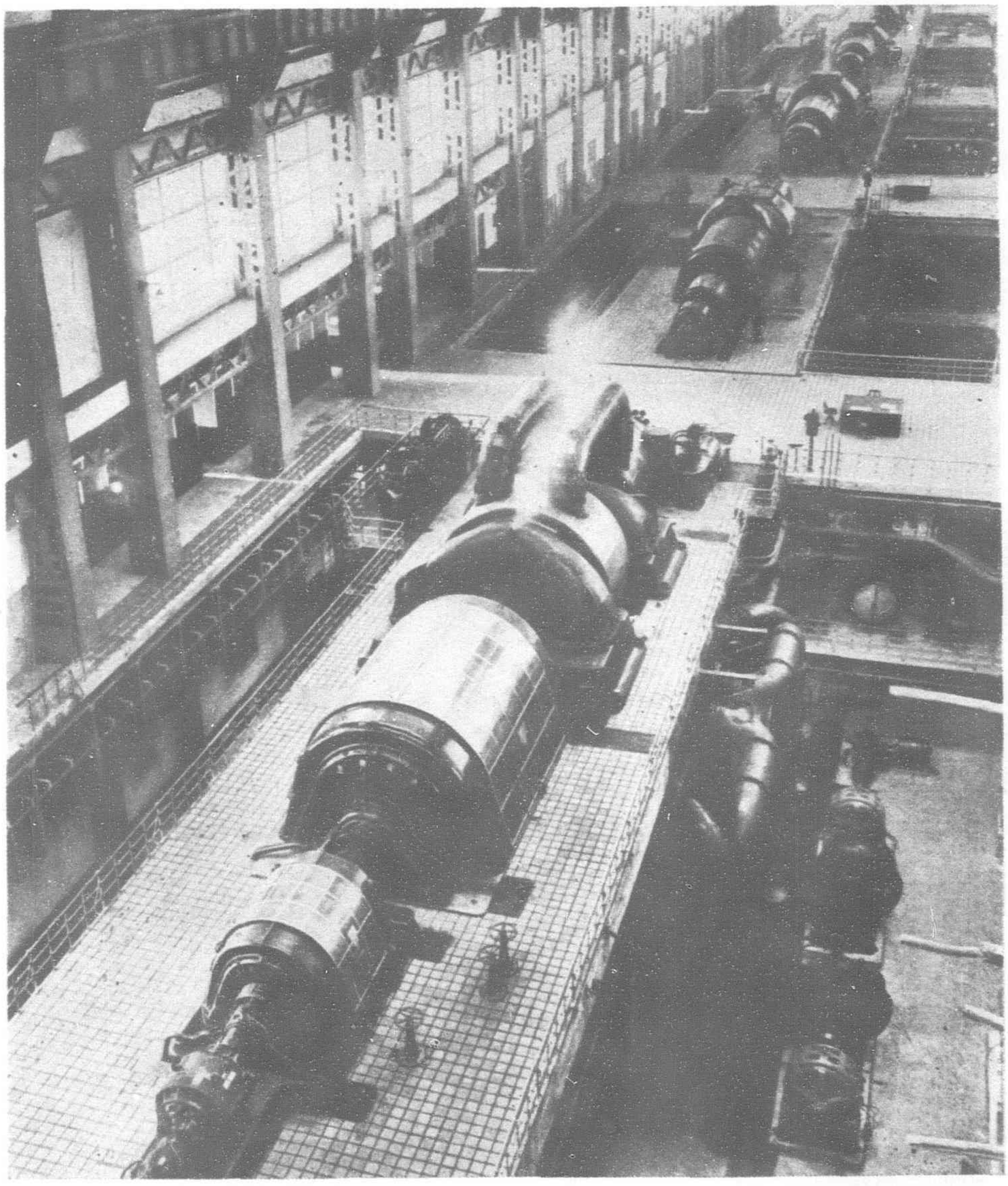


Fig. 5. Amagasaki Station constructed near Osaka of the Kansai Kyodokaryoku Hatsuden K.K. Installed capacity : 318,000 kw. (6 Units of 53,000 kw. Turbine generators—5 Units shown above). This Station was put in service in 1933 ; its second Station which will be equipped with three Units of 75,000 kw. Turbine-generators is planned

As to the industrial and other private electrical installations, at the end of 1936, there were 235 thermal-power stations belonging to those whose electrical installations are of not less than 1,000 kw., and their total output amounted to 674,460 kw. Although the average capacity is only 2,870 kw., there are 10 installations which are rated at more than 10,000 kw. The Nihon Iron Works, Ltd., has, in the Yawata Works, a steam-power plant with a capacity as large as 68,000 kw. Lately, industry has become animated, and many power stations are being constructed or extended. However, they are limited, partly due to the Government's guiding principle, to those utilizing process steam by means of bleeder turbines or back-pressure turbines, such as in rayon factories or soda factories, to those utilizing the waste heat such as in cement mills or iron works, or to those utilizing coal of poor calorific power in coal mines (see Figure 7). There are some power stations with internal combustion engines, of the order of 2,000 kw. output, but they are not described here.

Power Transmission

The pioneer installation of high-voltage transmission lines in Japan dates back to 1899, when two 11,000-v lines, each about 20 km long, were completed in Koriyama and Hiroshima districts. In 1909, the first 55,000-v transmission line was completed, in 1914 a long-distance transmission line over 230 km at 115,000-v, from Inawashiro No. 1 Station to Tabata Substation in the suburb of Tokyo, was successfully put into operation, and in 1923, a transmission line over 200 km at 154,000-v from Ryushima Station to Tozuka Substation near Yokohama, was completed. Since then, accompanied by the development of water-power in the central part of the main island as already stated, long-distance transmission networks of 154,000-v have been established towards Tokyo, Osaka, and Nagoya (see Fig. 8.). There are six 154,000-v transmission lines to Tokyo-Yokohama

district, consisting of four routes eight circuits belonging to the Tokyo Dento K.K., one route two circuits belonging to the Nippon Denryoku K.K., and one route two circuits belonging to the Daido Denryoku K.K. There are five 154,000-v lines to Osaka district, consisting of two routes four circuits of the Daido Denryoku K.K., one route two circuits of the Showa Denryoku K.K., one route two circuits of the Nippon Denryoku K.K., and one route two circuits of the Toho Denryoku K.K. The 154,000-v lines supplying to Nagoya district are: branch line of the Nippon Denryoku's Osaka line and a one-route two-circuit line belonging to the Yahagi Suiryoku K.K. As to the route lengths of these transmission lines, those to Tokyo are from 200 to 300 kilometers, and those to Osaka are from 240 to 370 kilometers. The future development of water-power naturally will soon make the existing transmission capacity insufficient, and a higher transmission voltage will consequently be considered necessary. Investigations are being made, both by the Government and by power companies, for the transmission at 220,000-v or above, so it will not be long before such high-tension transmission is realized.

Table IV shows route lengths of the transmission lines classified according to the kinds of conductors of various tensions at the end of 1935. Since Japan is a copper producing country, copper naturally predominates for the overhead transmission-line conductor. Steel-cored aluminium conductors are often used for transmission lines of 100,000-v or above. For 154,000-v lines, the ratio in circuit lengths steel-cored aluminium conductor to copper conductor is 41/59, while for 110,000-v lines this ratio is 17.5/82.5. For lines of voltages below 100,000-volts, the ratio becomes far smaller.

TABLE IV. ROUTE LENGTHS OF TRANSMISSION LINES IN KILOMETERS CLASSIFIED BY VOLTAGES AND KINDS OF CONDUCTORS

Kind of Conductor / *Voltage in volts*	*Copper*	*A. C. S. R.*	*Total*
154,000	1,746.2	1,211.9	2,958.1
110,000	850.8	179.8	1,030.6
77,000	2,402.5	147.5	2,550.0
66,000	6,934.2	543.7	7,477.9
55,000	1,357.1	14.5	1,371.6
44,000	1,785.1	0	1,785.1
Total	15,075.9	2,097.4	17,173.3

As Japan has a narrow area, high-voltage transmission lines often come near to or go parallel to weak-current lines, so the inductive interference becomes a serious problem, and has been studied from early days. From the standpoint of this inductive interference, the neutral point of the high-voltage transmission line was formerly exclusively grounded through a high resistance, but since the introduction of the arc-suppressing reactor in 1929, this device is very frequently adopted to every class of transmission lines ranging from 154,000-volts to 22,000-volts.

Power Generation and Transmission Project

In Japan the rationalization of electric-power generation and transmission has been discussed for the past decade, and, as a result thereof, in 1932 the Electric Undertaking Law was revised. Since then the plan of power generation and transmission is established annually by the Government and is put into discussion of the Electricity Commission. The chief object of this plan is to develop the total water-power most efficiently and rationally as well as to balance demand and supply by the economical power generation and transmission. In this plan the lands are divided into ten districts and for each district demanded power is estimated, the enterprisers' exploitation plans are fully investigated, and the ideal project of power generation and transmission is established to meet the situation. This plan covers a period of five years, and it is to be renewed every year. The first plan was decided in 1933 for three districts covering the central part of the main island, and at the end of 1936, the plan covering the entire district was first completed.

Japan has, generally speaking, no abundant natural resources, but water-power is the exception. Being within the economical transmission distances from the load centers, these water-power sites provide very valuable resources. In order that these water-power resources be utilized effectively and rationally, adequate steam-power plants must be operated jointly, and the fundamental principle for power generation is "water-power first and steam power second." General tendency of steam-power generation is to do away with the construction of many small power stations of low efficiency, to group them according to districts, and to construct power stations on large scales. Although the highest voltage of existing transmission lines connecting water-power stations and load centers is 154,000-volts, it is the general opinion to adopt, in the near future, a higher transmission voltage such as 220,000-volts or above, to rationalize the construction of water-power plants and transmission lines on a large scale.

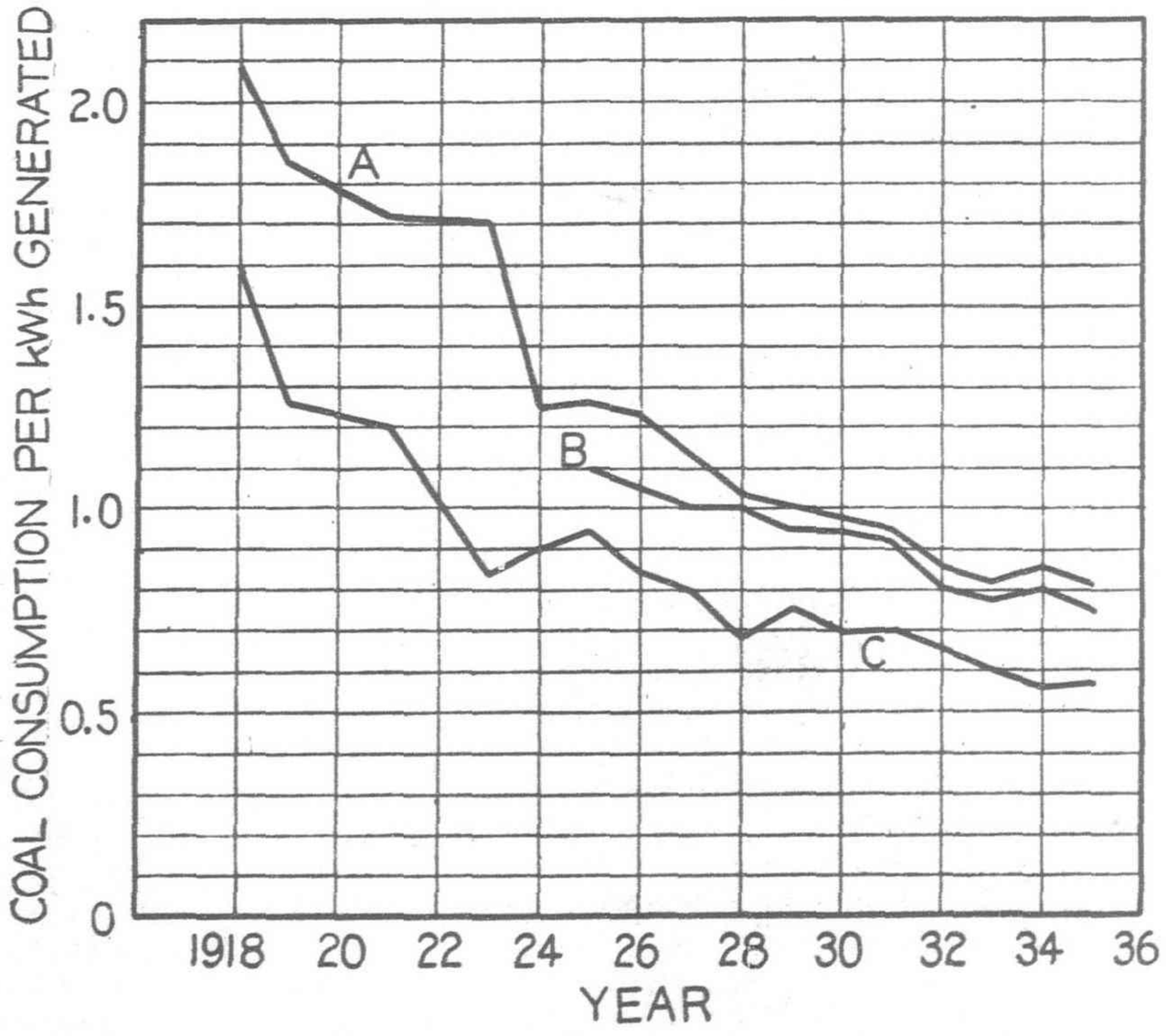


Fig. 6. Coal consumption per kwh generated of important steam-power stations in Japan

A: Average coal consumption of power stations generating 10 by 10^6 kwh or above per annum.
B: Average coal consumption of power stations with output 20,000 kw. or above.
C: Coal consumption of station of the best efficiency.

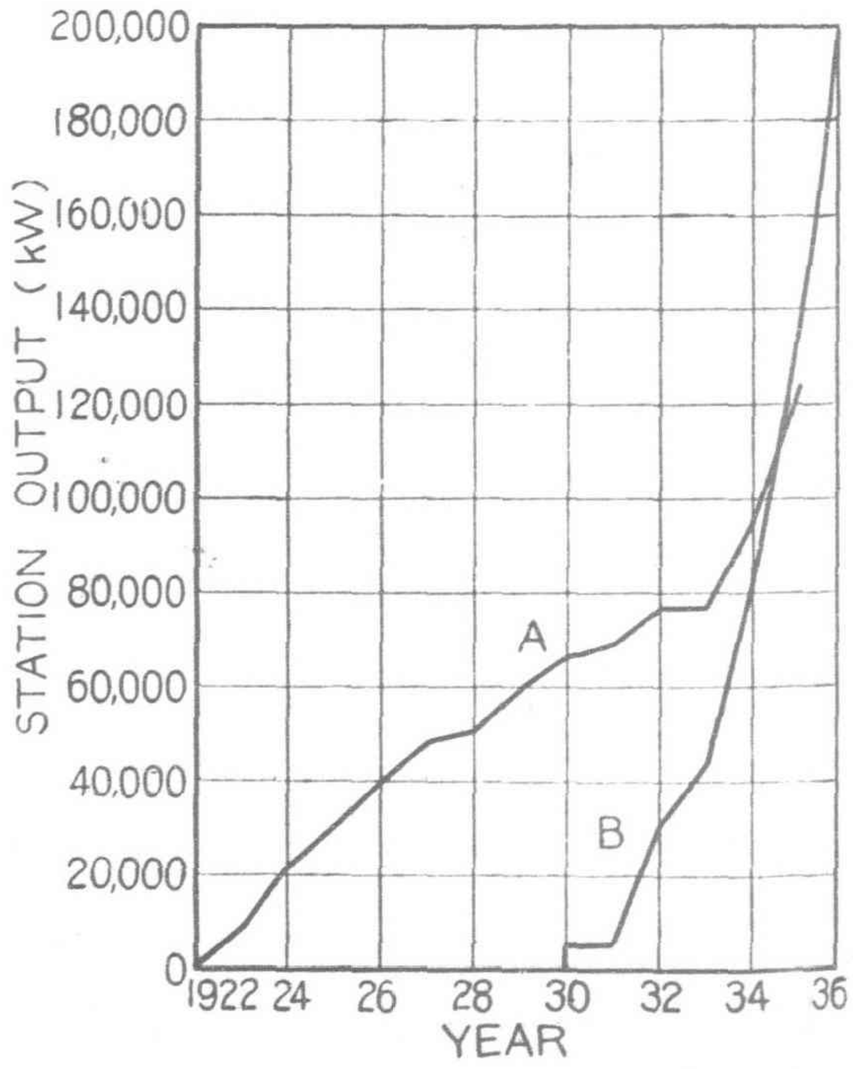


Fig. 7. Utilization of waste heat and process steam

A: Output of power stations utilizing waste heat of cement factory
B: Output of power stations utilizing process steam

Lengthening the Life of the Cylinder

CHROMIUM-HARDENED Diesel engine cylinders, treated by a new process which gives them four times the wear resistance of ordinary commercial cylinders, were exhibited by Messrs. R. A. Lister & Co., Ltd., of Dursley (Glos.) at the Motor Show.

The process is the result of eighteen months' research and experiments at Dursley, where a special laboratory and workshop were built to enable the experiments to be carried out in secret, without interfering with the normal running of the factory.

The new process, which has been registered under the name of "Listard" (Lister-hard), reduces cylinder wear, the bugbear of every engine user, to a minimum.

In view of the importance of the invention to the engineering industry, Messrs. Lister's have decided to make available the results of their experience to any British Diesel engine manufacturer taking up a licence to use the process.

Though "Listard" will be used only in Diesel engines, the principles on which it is made apply equally to motor-car engines, aeroplane engines and tools and machinery, where the increase of wear resistance affects the efficiency of the product. It may have far-reaching effects in the development of the Diesel motor-car and the Diesel aeroplane.

New Process Reduces Engine Wear

"Listard" is based on a Dutch invention brought to R.A. Lister & Co., in February, 1935. In March of that year experiments were put in hand on chrome-hardened cylinders.

Realizing from the beginning the importance of the invention if it could be applied commercially, Messrs. Lister's decided on the erection of a special plant and laboratory in which to make their own independent investigations and experiments. These were constructed while the original experiments were being carried out. The plant and laboratory were ready in August, 1935, and since then tests and experiments have been continued. The result is "Listard," on the development of which over £50,000 has already been spent.

"Listard" is, briefly, a chrome-hardening process. By electro-chemical means a deposit of chrome is deposited on cast iron. This gives a surface harder than anything of the kind yet known, a surface which resists both chemical and mechanical wear to a greater extent than ever before.

"Listard" is the result of successive experiments carried out at Dursley. The first problem was to find a satisfactory basis metal to give results. This led to the rejection of cylinders of hardened cast iron and cast iron in which hydrogen was present.

Experiments were then made to determine the effect of the "Listard" process on oil consumption and general efficiency, and to see how far existing lubrication methods had to be adjusted.

Next, tests were made to find out the most suitable class of finish for the cylinders—grinding, honing or lapping—after they had been processed.

Simultaneously with these tests, the cylinders were subjected to continual modifications to obtain the result desired.

As a result of trial and error, the tests ultimately gave the correct method of making the deposit, the best surface to finish in, and the best method of obtaining the finished surface.

This surface, for cylinder purposes, has the longest wearing surface yet discovered, the surface, that is, which gives the greatest efficiency over the longest period.

The tests to which "Listard" has been put at Dursley give conclusive proof that not even the hardest cast iron cylinders will stand up to the effects of wear, whether it is due to heat, chemical action, or abrasive wear from the piston rings, as effectively as cylinders treated with the "Listard" process.

The hardness of a cylinder is usually described in terms of degrees Brinell. This method is not effective where one metal is built on to the surface of another, as the soft metal underneath gives way to the pressure. A better method of testing its hardness is by scratching the surface under a given pressure with a hard object, such as a diamond, and measuring the depth of the scratch.

These are the results of actual experiments carried out at Dursley :—

1. Diameter 4½-in. Speed 1,000 r.p.m.
   One "Listard" processed cylinder
   One Nitrogen hardened cylinder
   Running side by side in the same engine, cold by day and hot by night, the combustion pressures being higher than normal.
   Total running hours 1,500
   Wear on the nitrogen hardened cylinder—4½ thousandths of an inch
   Wear on the "Listard" cylinder—1½ thousandths of an inch
   This gives a wear resistance in favor of the "Listard" of 300%
2. Diameter 4½-in. Speed 1,000 r.p.m.
   One "Listard" processed cylinder
   One Nitrogen hardened cylinder
   Running conditions similar to those in 1
   Total running hours 3,200.
   Wear on Nitrogen hardened cylinder—7 thousandths of an inch
   Wear on "Listard" processed cylinder—2½ thousandths of an inch
   This gives a wear resistance in favor of the "Listard" of 310%
3. Diameter 4½-in. Speed 650 r.p.m.
   Engine running as 1 and 2, but the lubricating oil mixed with 50% fuel oil
   Total running hours 3,000.
   Wear on Nitrogen hardened cylinder—12 thousandths of an inch
   Wear on "Listard" processed cylinder—1½ thousandths of an inch
   This gives a wear resistance in favor of the "Listard" of 800%.

A large number of "Listard" cylinders are now under practical test in many parts of England. These are being periodically inspected, and all show excellent results. Others are on test in foreign countries. In not a single instance has any failure been reported.

IMPORTANT NEW PUBLICATION

IT is with the purpose of placing the dramatic story of the new State of Manchoukuo before the eyes of the Occidental World, that an important new bi-monthly journal has made its appearance, sponsored by the South Manchuria Railway Company as Publisher. This is *Contemporary Manchuria*, which, in its Vol. 1, No. 1 issue, appearing in April, is an attractively printed, book-size magazine, which carries between its blue paper covers some one hundred and fifty-odd pages of interesting and highly informative matter.

Outstanding among the contributions to this first number of the new magazine is a historical record of the South Manchuria Railway Company, written by its President, Mr. Yosuke Matsuoka, and this is reproduced editorially in this issue of *The Far Eastern Review*. The South Manchuria Railway Company is far and away the greatest organization of its kind in the Far East, but even in the Far East not many are aware that this Company, if not in magnitude, then in the diversity of its manifold interests, is unique among the great business enterprises of the world.

Other arresting articles in the initial number of *Contemporary Manchuria* are devoted to the "Bean Oil Industry in Manchuria," "Prevention of Cattle Diseases in Manchuria," "The Manchouli Conference and Its Background," "The Present Situation of the Red Activities in China and Manchuria," "Electricity in Manchuria," "Improvement of Agricultural Products," and, under the title, "Milestone of Progress" a record of events in the State of Manchoukuo. In a foreword that supplies the reason for the publication of the new magazine, Mr. Matsuoka writes as follows :—

Changing Manchuria—that is the vibrating reality of contemporary Manchuria.

Within a short span of four years, Manchuria has witnessed unprecedented changes which are unrivalled anywhere in the modern age. For the first time in its long history, peace and order have been achieved under an honest and efficient political administration ; State finances have been modernized and minutely budgeted ; complicated currencies have been completely unified and nationalized ; tax burdens have been radically reduced and rationally redistributed ; dying industries have been rejuvenated and new industries fostered ; trade has been resuscitated and grown with leaps and bounds ; construction activities have shown the greatest boom of modern times ; new railway and bus lines have penetrated the remotest hamlets and backwoods ; postal services have been

(Continued on page 249)

Railway Construction in Manchuria

TOPOGRAPHICALLY, the coastal line of Manchuria is not lengthy while natural river transport facilities save for the great Sungari and Liao rivers are rather unimportant. Kept from modern civilization for many centuries as a "forbidden land," Manchuria, even fifty years ago was regarded by the world as a remote and unproductive area, despite its natural resources and vast and fertile tracts of land capable of cultivation.

Manchuria of the present day stands out in sharp contrast to what it was half a century ago ; this land now ranks among the principal agricultural countries of the world and is a great supplier of coal and iron, the two minerals which may be termed the food for all modern industries. It is then necessary to know what accounts for this rapid development of Manchuria in the realm of world economics.

Everybody will admit that unless a network of railways had been spread over Manchuria, the country would have lagged behind the times as an uncultivated and unproductive land. The introduction of railway communications, it may be said, is responsible for the emergence during the past five decades or so of Manchuria as a land of international economic importance.

It was not on China's own initiative that the first railway was installed in Manchuria. Planning to invade Manchuria, Czarist Russia in 1896 concluded with China a secret protocol whereby the former acquired the right to install the old Chinese Eastern Railway which was re-christened the North Manchuria Railway after the creation of the Hsinking Government. Work on the construction of this line was immediately started. A couple of years later or in 1898, another agreement was signed between the two Governments this time regarding the installation and management of a railway into South Manchuria as a branch line of the Chinese Eastern Railway.

How Manchuria's railway construction has progressed from that time until the establishment of Manchoukuo may be summed up in the following brief chronicle of related events occurring during this period :

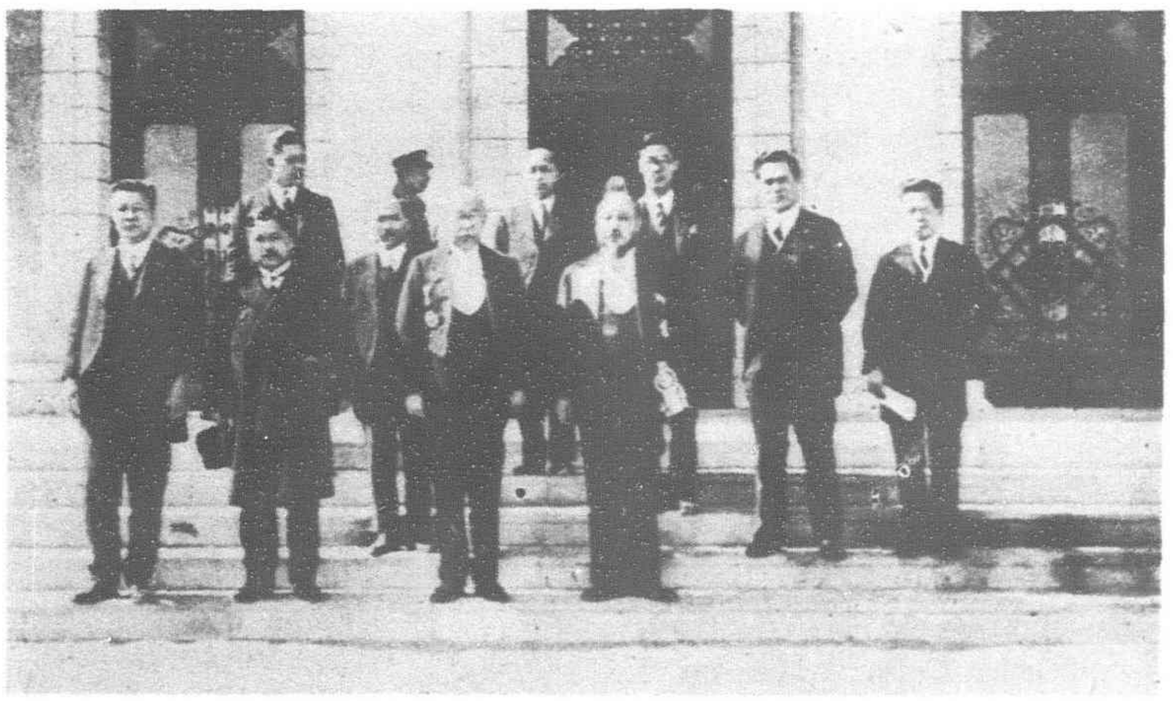
(1) 1896 : A secret convention was signed between Russia and China, whereby the former obtained the right to construct the Chinese Eastern Railway, the building of which was immediately started.

(2) 1898 : A preliminary contract for a British loan to China for the erection of a railway from Peiping to Newchwang was signed. An agreement was also concluded between Russia and China regarding the installation and management of a branch-line in South Manchuria of the Chinese Eastern Railway.

(3) 1899 : An Anglo-Russian convention appropos of railways in China was signed. Russia and China exchanged memoranda under which the former was given the right of preference to install railways in the territory north and east of Peking to the Soviet frontier.

(4) 1900 : The Peking-Mukden railway was extended from Koupangtzu to Tahushan.

(5) 1902 : A preliminary contract on the installation of a railway between Kirin and Changchun (now Hsinking) was signed between Russia and China. The construction work of all sectors of the Chinese Eastern Railway was completed.



South-Manchurian Railway President Hayashi and Minister of Communications Ting leaving for the North Manchuria Railway Transfer Ceremony

(6) 1903 : The whole of the Chinese Eastern Railway was opened to business. The Peking-Mukden railway was further extended from Tahushan to Hsinminfu.

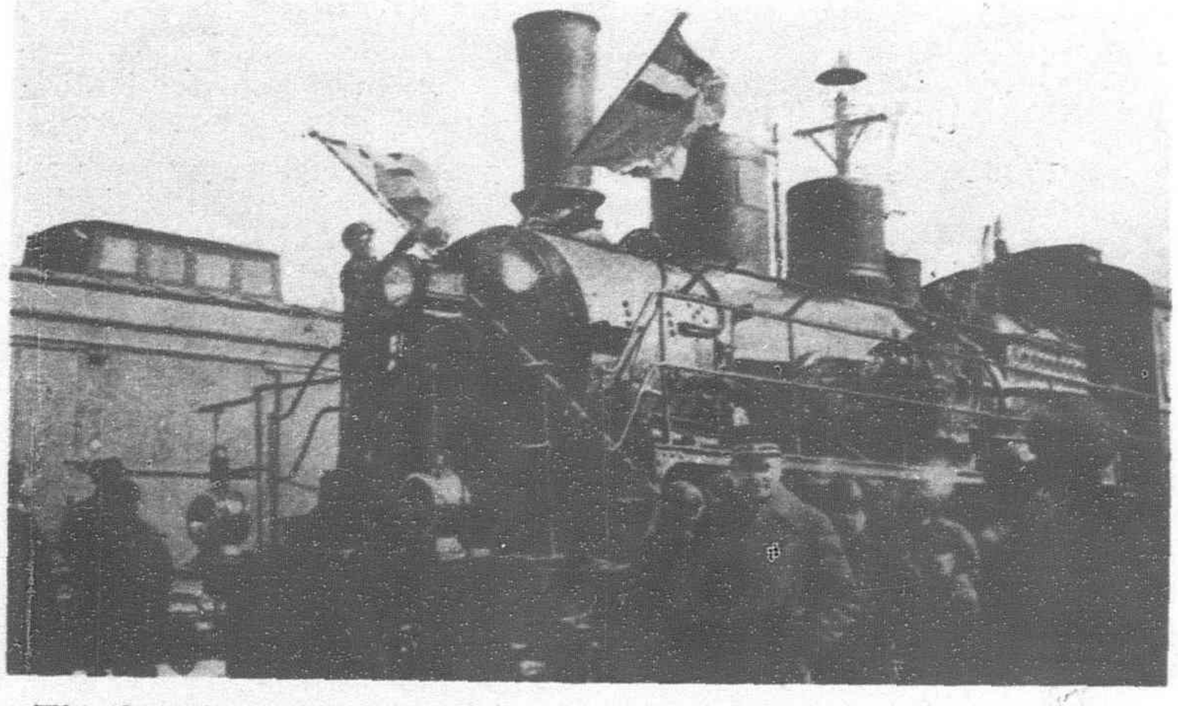
(7) 1904 : The Russo-Japanese War broke out. A light railway between Antung and Mukden was installed by the Japanese Army.

(8) 1905 : Another light railway was constructed by the Japanese Army from Mukden to Hsinminfu. In the Portsmouth Peace Treaty signed on September 5, 1905, Russia transferred to Japan her lease of the Kwantung Territory, the railway between Dairen and Changchun, now Hsinking, together with its branch lines.

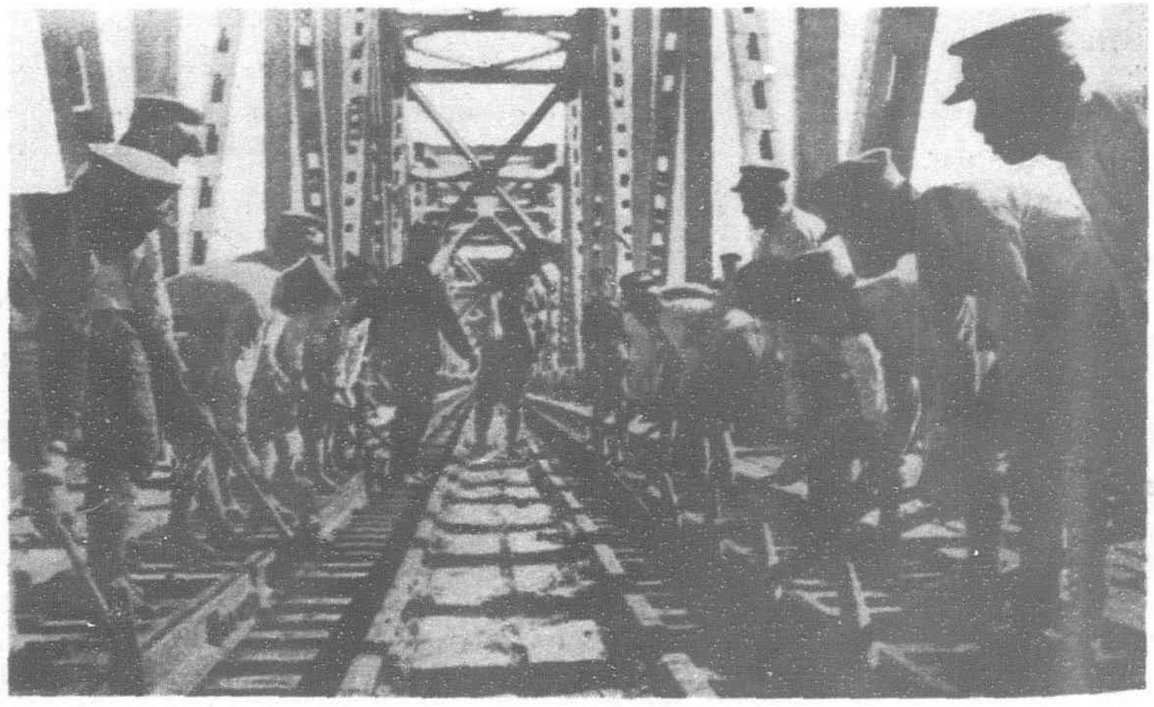
(9) 1906 : The South Manchuria Railway Company was organized to operate all railway lines in South Manchuria.

New Railways

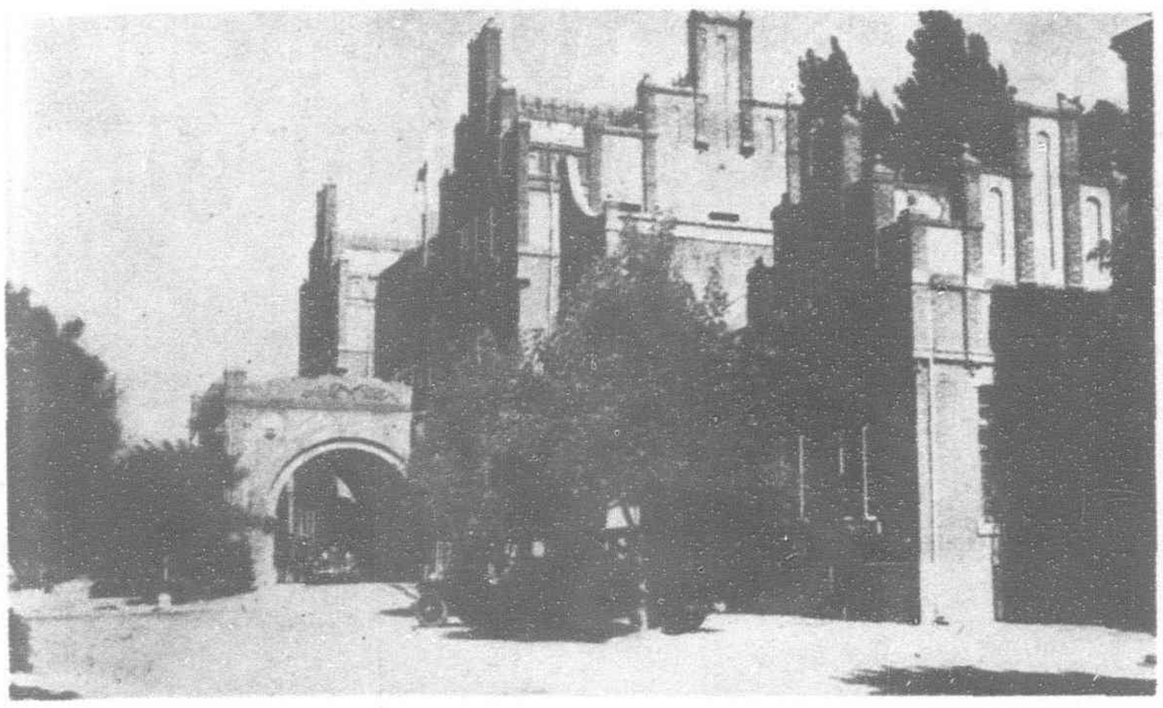
From 1907 to 1931 when the Manchurian Incident broke out, many new railways were installed largely by the South Manchuria Railway Company on contracts with the Chinese authorities. With the birth in 1932 of Manchoukuo, all railways thus erected in Manchuria, save for those owned and managed by the South Manchuria Railway Company, were automatically taken over by the Hsinking Government. Many more lines have since been



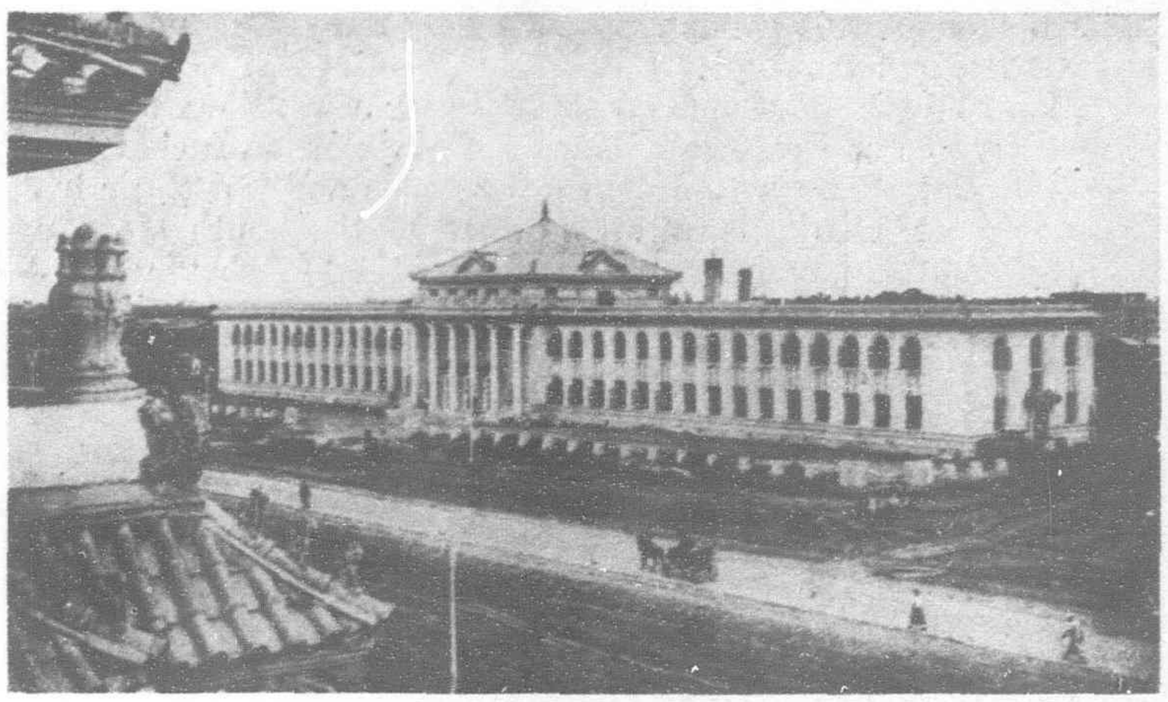
The North Manchuria Railway passes from the Soviet Hands to Manchoukuo



Changing the gauge of the Hsinking-Harbin Line



The General Direction of Manchoukuo State Railways, Mukden



The Department of Communications, Hsinking

installed throughout Manchuria by the new State, perfecting the present network of railways.

Furthermore, the Chinese Eastern Railway, 1,720 kilometers, was transferred to Manchoukuo in March, 1935. Thus, the mileage of railways in Manchuria since the Manchurian Incident has rapidly increased. The total length of railways as at the end of September, 1936, was 8,771.4 kilometers, including 1,130.5 kilometers representing the lines owned by the South Manchuria Railway Company, 7,295.5 kilometers owned by the State of Manchoukuo and 345.4 kilometers, private-owned.

After the completion of the fourth railway construction program to be launched this year, the length will be increased further to 12,000 kilometers. Under a decree issued by the Hsinking Department of Communication on February 9, 1933, all railways of the Manchoukuo State came under the management of the South Manchuria Railway Company. With a view to rationalizing the operation of the vast railway network, the company in October, 1936, created in Mukden the General Direction of Railways entrusted with the uniform management of all lines in Manchuria and North Korea.

This Mukden institution, led by Vice-President Takuichi Ohmura of the South Manchuria Railway Company, not only manages the running of 8,770 kilometers of railways, but also supervises the construction of new lines and harbor facilities. There are at present 32 Manchoukuo State railways whose actual operation is undertaken by five local railway bureaus and two offices.

The South Manchuria Railway trunk line between Dairen and Hsinking, 701.4 kilometers, is the most important of all Manchurian railways. Because this line has as one of its termini the port of Dairen and because it passes through what is called the granary of South Manchuria, the larger portion of local farm produce for export and incoming commodities for distribution in the hinterland is transported by this railway.

In point of importance, the Hsinking-Tumen line, 568 kilometers, and the Tumen-Chiamussu line, 444.9 kilometers, which run through the northeastern districts and are linked with the three North Korean ports, Yuki, Seishin and Rashin, come next. By these two lines, the majority of farm produce and lumber from North-east Manchuria are taken to the three ports for shipment abroad.

In order to meet the steady growth of commodities to and from the northeastern districts of Manchuria by these two lines via North Korea, the South Manchuria Railway Company has already established gigantic harbor facilities, especially at Rashin, which is capable of handling three million tons of cargo annually.

The third important line is the Mukden-Shanhaikwan railway, 419.6 kilometers, which is linked with North China by the Peiping-Shanhaikwan railway. Naturally, this line plays the principal rôle in the overland trade between Manchuria and North China. The fact also must not be overlooked that along the line are two good ports, Hulutao, Chinchow Province, and Hopeh, Fengtien Province, both of which face the Gulf of Pechili. These two ports add a great deal to importance of the Mukden-Shanhaikwan railway.

Roughly speaking, all other railways may be regarded as "feeder-lines" for the foregoing four principal railways, although there is no need to say that as the districts through which they pass are cultivated for agriculture and industrialized, their importance will be multiplied. Below is a list of the main Manchurian railways operated by the Mukden General Direction :

(*a*) Owned by the S.M.R.

		kilometers
1.	Dairen-Hsinking trunk line	701.4
2.	Mukden-Antung line	260.2

(*b*) Owned by Manchoukuo

3.	Mukden-Shanhaikwan line	419.6
4.	Tahushan-Chengchiatun line	366.2
5.	Chinchow-Chengte line	436.1
6.	Yehpaishou-Chifeng line	146.9
7.	Mukden-Kirin line	447.4
8.	Ssupingkai-Meihokou line	156.3
9.	Hsinking-Tumen line	568.0
10.	Tumen-Chiamussu line	444.9
11.	Hulin-Linkou line..	170.9
12.	Lafa-Harbin line	271.7
13.	Harbin-Peian line	326.1
14.	Peian-Heiho line	302.9
15.	Tsitsihar-Peian line	231.5
16.	Hsinking-Paichengtzu line	332.6
17.	Paichengtzu-Harbin line	250.5
18.	Hsinking-Harbin line	242.2
19.	Harbin-Manchouli line	934.8
20.	Harbin-Suifenho line	546.4

Manchuria is a predominantly agricultural and mineral country. This fact is clearly reflected in the kinds of goods transported by the railways. According to statistics released by the South Manchuria Railway Company, coal represented 45 per cent of the total volume of goods transported by its railways during 1935. Soya beans came second with 11.6 per cent, followed by other staple farm products with 6.9 per cent. Authoritative statistics regarding the Manchoukuo State railways are lacking. The volume of coal, soya beans and other farm products handled by the lines owned by the South Manchuria Railway Company from 1907 to 1935, are given in metric tons in the following table :

	Coal	*Soya beans*	*Other staple farm produce*
1907	148,969	184,032	190,684
1911	1,330,167	617,092	333,651
1914	2,494,854	920,504	533,886
1917	2,623,843	1,067,806	852,195
1921	3,404,026	1,660,079	1,679,801
1926	7,269,176	2,130,261	1,901,159
1929	8,936,720	2,990,616	1,665,227
1931	7,326,379	2,923,087	1,542,429
1933	8,653,397	2,557,906	1,596,471
1934	9,299,834	2,767,876	1,740,326
1935	9,570,806	2,439,960	1,444,618

As regards soya beans and other farm produce, their volume transported by rail is subject to fluctuation according to demand abroad, especially in Europe, and their annual crops.

There is no doubt that as the land is industrialized, as planned, and large numbers of Japanese farmers are sent in for the reclamation of uncultivated districts, especially in North Manchuria, there will

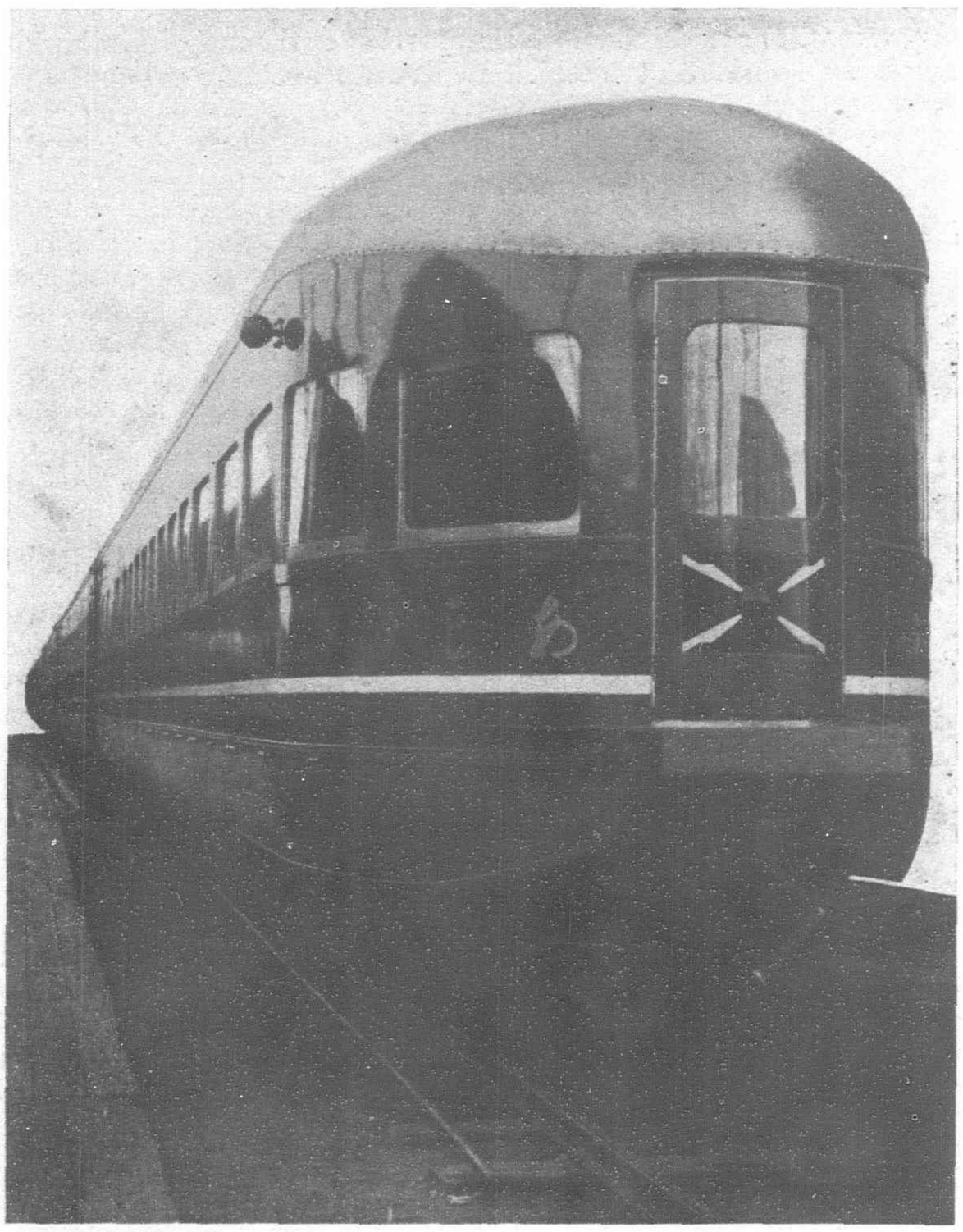
occur a sharp rise in goods transported by rail either for domestic distribution or for export.

How rapid the development of the Manchurian railways has been in recent years and especially since the Manchurian Incident, may also be explained by actual figures for goods and passenger traffic proceeds recorded by the railways owned by the South Manchuria Railway Company, and those possessed by the Manchoukuo State :

1. S.M.R. Line

(*a*) Goods Traffic

	Volume metric tons	*Amount yen*
1931	15,454,213	70,897,755
1932	16,572,816	85,022,314
1933	18,850,840	94,263,019
1934	21,671,342	101,489,276
1935	20,980,701	103,362,261



A rear view of the most famous fast train in the Orient—the Asia—streamlined, super-express on its run between Dairen and Harbin

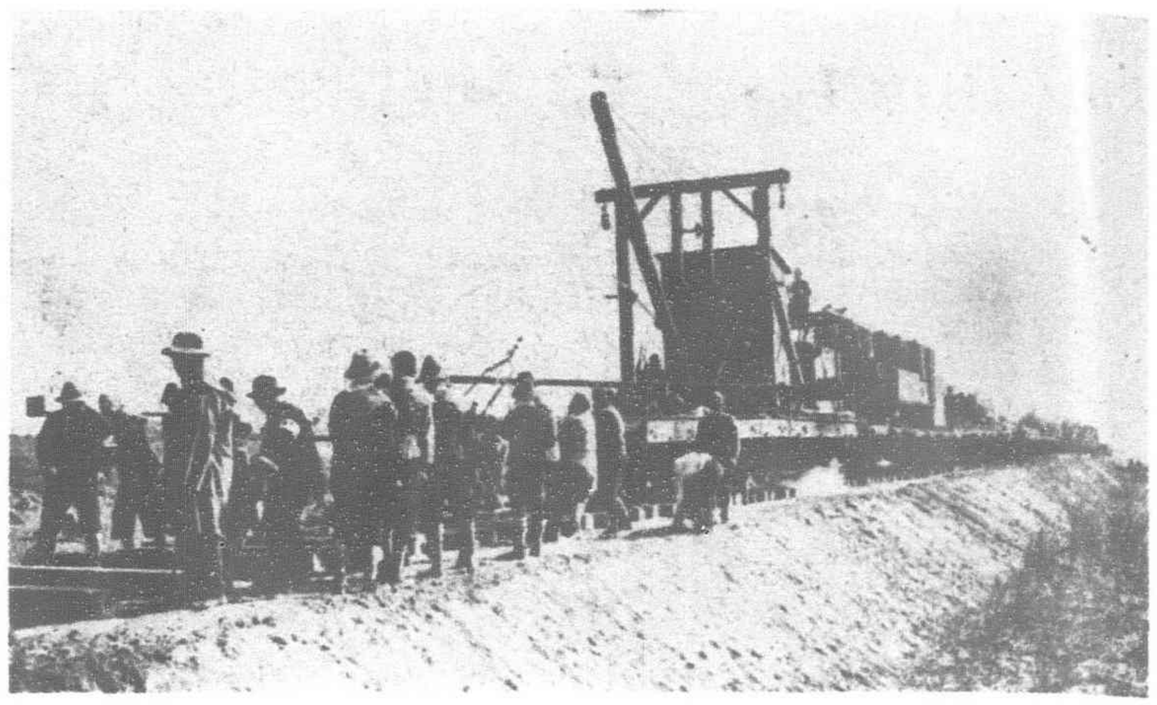
(*b*) Passenger Traffic

	Number persons	*Amount yen*
1931	6,331,760	9,135,663
1932	8,610,159	14,812,045
1933	11,633,875	18,757,362
1934	13,786,403	20,332,876
1935	15,122,922	22,412,222

2. Manchoukuo State Lines

(*a*) Goods Traffic

	Volume metric tons	*Amount yen*
1933	8,900,041	36,079,643
1934	11,859,500	50,513,474
1935	15,101,882	72,833,514



A scene of the Railway Construction Work

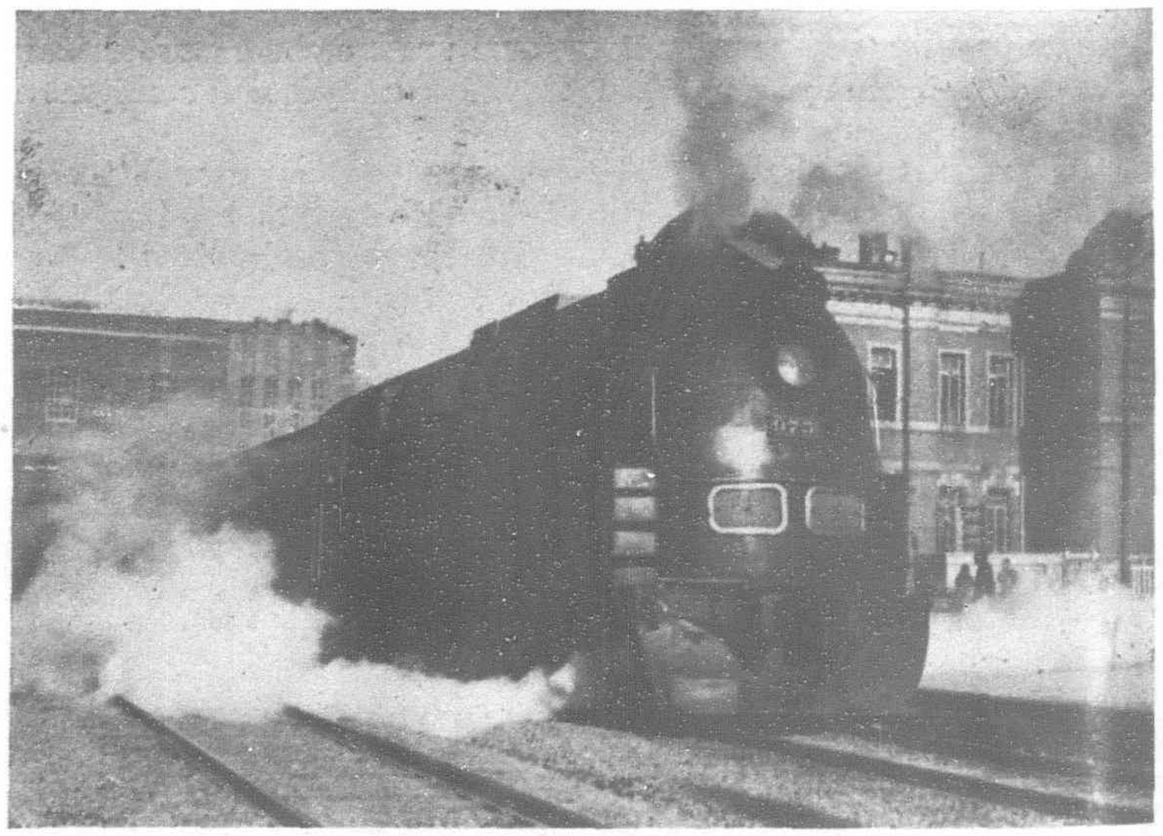
(*b*) Passenger Traffic

	Number persons	*Amount yen*
1933	8,073,301	14,706,341
1934	9,156,947	17,851,910
1935	14,105,552	28,678,252

The combined revenue from goods and passenger traffic of all Manchurian railways owned by the South Manchuria Railway Company and Manchoukuo, including the North Korean lines, was Y.167,223,000 in 1936 against Y.144,861,000 in 1935. The total volume and number respectively for goods and passengers by them during 1937 were 29,283,000 metric tons and 21,908,000 persons as compared with 25,180,000 metric tons and 20,509,000 persons in 1935.

In 1907, the traffic revenue of the South Manchuria Railway Company was only 9,678,887 yen as compared with some 135 million yen. In other words, the revenue during the past three decades has been multiplied nearly fifteen times. It is also interesting to note that the company in 1907 netted a profit of 3,667,276 yuan which jumped 30 years later, in 1936, to 84,030,328 yen, a a sum nearly twenty-seven times as large.

According to statistics compiled by the Mukden Railway Direction, 13,272,400 square kilometers of land are already under cultivation in districts traversed by the Manchoukuo State lines already installed, in addition to approximately 16,530,000 square kilometers still awaiting cultivation. The total area of forests in these districts, the same statistics reveal, is estimated at 216,745 kilometers, from which more than 3,508 million cubic meters of lumber are obtainable. Now, the exploitation of Manchuria's farm, industrial and mineral resources is in full swing, and it is trite to say that as time passes, the importance of railways will increase tremendously.



The streamlined locomotive of the Asia

Engineering Enterprise by the Swedish East Asiatic Co.

The special correspondent of *Lloyd's List* (London) writes :—

THE Swedish East Asiatic Company possesses a fleet of six steamers and nine motor-ships trading to Japanese and China ports on the one hand, and to Indian ports on the other. The Diesel-engined vessels go back to the Formosa, of 1921, with 2,390 h.p. in service, and one of the newest is the *Tamara*, of 1931, 10,030 tons d.w., 3,450 h.p. on twin screws, and 13½ knots. The *Formosa* is not in line with modern requirements as regards speed, and, like certain units in other fleets, is to be taken in hand for repowering. This is to be carried out with the object, it is stated, of increasing the service speed by 2½ knots. Thus the *Formosa* will resemble, from this point of view, the newest ships of the fleet and will be brought more into line with the trend of cargo liner powering generally.

As built, the *Formosa* was powered by two sets of Burmeister & Wain four-cycle single-acting air-injection cross head Diesels, each having six cylinders, 24.81-in. diameter and 37.81-in. stroke, rated for a total of 2,390 b.h.p. at 125 revolutions. This gave her a speed of about 11 knots under best conditions when loaded down to 29-ft. 0¼-in., her dimensions being 425.4-ft. by 55.1-ft. by 35.4-ft. She is a shelter-deck ship, like the majority of vessels of this company, with a divided deck structure, the forward part of which serves as the navigation house and the other part as the engineers' quarters, round the engine casing.

A Significant Change

In view of important developments which have taken place since 1921, both with four-cycle single-acting airless-injection pressure-charged Diesels and, more important still, with double-acting two-cycle airless-injection units, it would have been thought that repowering could easily be carried out by the substitution of the two-cycle type for the older four-cycle engine. The fact that four single-acting two-cycle attached-scavenge-pump Diesels are to be substituted for two four-cycle engines is of considerable significance not only from the point of view of re-engining the *Formosa* but with regard to motor-ship driving generally.

The engines will be perfectly normal Polar Atlas type Diesels such as are well known for auxiliary purposes and for use in coasters in this country. Two engines will drive each shaft through mechanical gearing and Asea electro-magnetic slip coupling, which has been alluded to from time to time in *Lloyd's List*. It is further significant to note that the work of conversion will take place at the yard of Kockums Mekaniska Verkstads A/.B, an important member of whose present technical staff was at one time very actively associated with the Atlas organization.

The use of standard medium-powered engines means that a fairly low machinery weight and height should be secured. To the employment of electro-magnetic slip couplings the only alternative, if indirect drive is visualized, is hydraulic couplings. Even their best friends will admit that these are somewhat heavy and take up at least as much space as the electric system, while in flexibility it is probable that on balance there is little to choose between the two systems.

In a cargo liner flexibility is hardly a matter of prime importance, for a ship of this kind is expected to run between ports at her maximum speed, whether in ballast or not, and would obtain but small benefit from the ability to cut two of the four propelling engines.

In a perfectly new installation the Atlas-Asea arrangement suggests low headroom for the main machinery, and this, again, brings to the fore the possibility which has been striven for by designers for some time of carrying the 'tween decks all fore and aft over the machinery and thus gaining extra space. It is questionable whether such a machinery arrangement in a new ship would be as economical in fore and aft space as a pair of direct coupled double-acting two-cycle Diesels. On the other hand, these would undoubtedly be at least twice as high.

The choice then becomes one for the shipowner, who, knowing the special requirements of his own trade, must decide whether he wishes to have an engine equipment spread fore and aft over the tank top or one restricted horizontally but with no limitations as to height. As far as the *Formosa* is concerned, the engineers will be dealing with a machinery space of established size, although modifications will certainly be needed to the seatings and double bottom of the ship which would not be required had direct-coupled engines been employed.

It has been claimed for this new equipment that the engine power will be more than doubled, that is to say, the ship should now have between 5,000 and 6,000 h.p. on the two screws, thus bringing her into line with a number of the fastest Japanese and many of the Dutch and Norwegian cargo liners. Even so, it is stated that the new machinery weighs less and requires less space than the existing plant. This, in itself, is a striking tribute to the lightness of standard engines and of the electrical gear. It is also stated that the loading capacity of the *Formosa* will be increased by about 100 tons.

It is not stated whether modifications will be made to the bow or the stern of the vessel in order to enable her to carry her increased power, but it would seem likely. This conversion has been purposely emphasized in these columns as having significance not only for conversion work but for new construction, particularly by certain shipowning groups in this country.

Space does not permit a detailed description of the Asea election-magnetic ship coupling, but it may be recalled that the principle upon which it is constructed comprises an inner multi-polar magnetic ring, known as the primary, the excitation for which is obtained by D.C. through two slip rings, and an outer part or ring provided with a short-circuited winding known as the secondary.

The inner part is connected to the high speed side of the mechanical reduction gear and the outer to the Diesel engine. The two parts of the coupling are thus overhung on their shafts, and there are no mechanical connections between them. In fact, the radial air gap between primary and secondary is from 5 to 10 mm., depending on the size of the equipment and the engine speed.

Operation is secured by the excitation of the primary which causes a magnetic field, the lines of force passing from the poles across the air gap and round the secondary conductors. Even at small relative differences in speed between the two coupling halves powerful currents are in use in the secondary windings, which produce resistance to this relative movement and thus effect transmission of torque between primary and secondary parts of the coupling. Coupling and decoupling is performed by closing or opening the excitation current circuit, which is generally designed to be fed from the main lighting system of the vessel.

At low ship speed and where there is frequent starting and stopping the engine can run continuously at a low speed, and the propeller can be run and stopped by switching excitation on and off, using the coupling as a clutch and thus simplifying manœuvring and economizing on starting air. The arrangement is not a new one, and has been fitted to a number of ships of different types now, in service or completing.

Taikoo Dockyards Busy

Work has commenced at Taikoo Dockyards on *No. 276*, the largest ship to be built in Hongkong.

No. 276 is the designation for one of the two sister ships ordered in Hongkong by Messrs. Alfred Holt & Co. for their Blue Funnel Fleet.

The keel was laid with little if any ceremony, and work is already progressing at a considerable rate.

The sister ships will be constructed simultaneously. It is expected that the keel of *No. 277* will be laid in July or August.

The two ships will be of 10,000 tons each, and will be diesel-engined. Although intended primarily as cargo ships, they will be luxuriously fitted to carry a few passengers.

Over a thousand men will be employed until the end of next year on their construction. They will probably be launched late in 1938 or early in 1939.

Construction will also commence at the W. S. Bailey & Co. shipyards on another vessel in the near future.

It is understood that a contract has already been signed with Philippine interests for the construction of this vessel, which will be a passenger-cargo ship of considerable dimensions, and the largest to be constructed in these yards.

M.A.N. Engined Motorships for Shanghai-Chungking Service

THERE are now about a dozen German geared Diesel ships operated by the Chinese Maritime Customs Service and at least another dozen under construction for other services. It is evidently the view of Chinese shipowners that the indirect drive should invariably be employed, utilizing high-speed Diesel engines, either with electric transmission or gearing. Ships up to liners of 25,000 tons gross are being built with such machinery in Europe and elsewhere.

Here in China the latest order placed with the M.A.N. Company has been that of the Mingsung Industrial Company, Limited, for two motorships to be constructed at the Hou Hsin Dock in Shanghai. The Mingsung Industrial Company is operating a regular passenger and freight service between Shanghai and Chungking for which the two motorships are intended.

Some particulars of the performance of these ships, equipped with M.A.N. direct reversible, solid injection Diesel engines, will be of interest, not only to shipowners who have not adopted the arrangement, but to engineers, many of whom admittedly question the desirability of utilizing propelling engines in single block construction.

The *Mingching* already built and placed in service is the first of the sister ships, and the following description deals with her. Her dimensions being :

Length O.A.	144-ft. 9-in.
Length B.P.	136 ,, 9 ,,
Beam	26 ,,
Displacement	253 tons

The ship has passenger accommodation consisting of eighty cabins of various classes and is easily the most comfortable and most modern ship on the river.

The propelling machinery consists of two M.A.N. Direct reversible, solid injection Diesel engines, each developing 500 h.p. These engines are of the well-known M.A.N. design in single block construction with individual fuel pumps for every cylinder and steel tie-rods to relieve the casting of pressures resulting from compression and combustion.

Large openings in the crank case permit ease of inspection and attendance to the running gear.

Some special features for the operation on the muddy waters of the Yangtze have been incorporated in this engine. Special wide bed plates have been provided and well laid out foundations provided by the shipbuilders have taken up these engines.

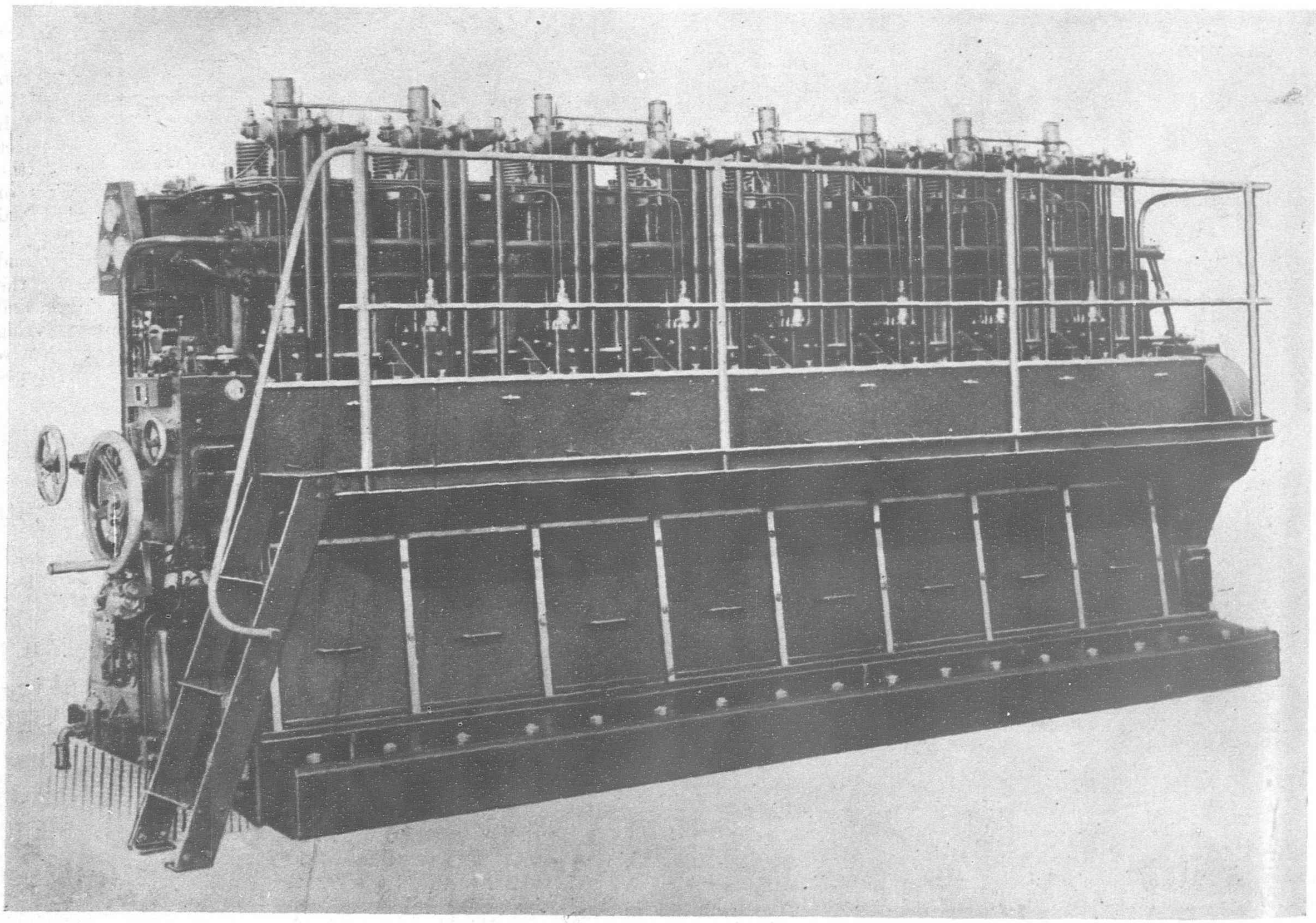
The Mingsung Industrial Co., Ltd., contracted with the Hou Hsin Dock a speed, fully loaded, of 11½ knots. In actual trials, the *Mingching* exceeded this contract by far, inasmuch as an average speed of 12.75 knots was reached. The engines operated during the trials quietly and without vibrations. The fact that a speed far beyond the contracted one was reached speaks well for the ability of the shipbuilders, as well as for the good quality of the M.A.N. Diesel engines.

The *Mingching* went into service on April 21, and has concluded her first round-trip back to Shanghai.

The different sections of the river were covered by the ship as follows :—

UP RIVER

	Miles	*Hours— Av. Speed*	*Knots*
Shanghai-Hankow ..	620	59½	10.23
Hankow-Ichang	384	40	9.6
Ichang-Chungking ..	350	43	8.1



M.A.N. designed, Direct Reversible Diesel Engine, in single Block Construction with Individual Fuel Pumps for every cylinder, as in use on the "Mingching" of the Mingsung Industrial Company, Ltd., for Service on the Shanghai-Chungking Line

DOWN RIVER

		Hours—		
	Miles	*Av. Speed*	*Knots*
Chungking-Ichang ..	350	22	15.8
Ichang-Hankow	384	31	12.1
Hankow-Shanghai ..	620	41	14.5

It is noteworthy to mention that these speeds were reached with reduced revolution of the engine.

The second boat of this class, at present being fitted out, is expected to show the same good results.

* * *

Diesel Liners for the Far East

Supplementing the foregoing a special correspondent recently contributed the following informative article to *Lloyd's List* :—

Among the many important vessels now building in Holland is a single-screw motorship for the Java-China-Japan Line, an important company maintaining those connections naturally suggested by its name, and at present owning a fleet of ten steamers and two motorships, the *Tjinegara* and *Tjisadane*, completed in 1931 at the yard of the Netherland Shipbuilding Company. Generally speaking, the fleet is fairly up to date, although there is one unit going back to 1914 and another to 1918. It has long been an open secret, however, that new construction would take place as soon as any improvement showed itself in shipping, and the new contract which has also gone to the yard of the Netherland Shipbuilding Company is the result.

The ships of the fleet maintain a passenger and cargo service at many ports between Batavia and China, and are subject to severe extremes of climate as well as to various types of cargo-handling appliances in the ports to which they trade. Self-sufficiency in this latter respect is important, therefore, and the two latest motorships have an equipment of electric cranes in addition to their derricks.

In view of the improvements which have taken place since the first two motorships of the Java-China-Japan Line were completed, it is interesting to give some particulars of the vessel now under construction, and to contrast these with the characteristics of the older pair. The new ship will have a length over all of 479.9-ft., and a length between perpendiculars of 450-ft. ; the beam moulded is stated to be 54.5-ft., and the depth moulded to the upper deck 38.5-ft. The deadweight capacity is about 10,000 tons and accommodation is to be provided for 51 first class passengers, 55 second class and 100 third class.

The *Tjinegara*

The *Tjinegara* and *Tjisadane* have each a deadweight capacity of 9,000 tons and are of 9,227 tons gross, dimensions being 440.6-ft. by 62.2-ft. by 34.4-ft., the draught loaded is 29-ft. and the speed in service about 14 knots on 26 tons of fuel per day. Propulsion of the older ships is by a Werkspoor-Sulzer two-cycle single-acting air-injection engine, directly coupled to a single screw and driving its own scavenge pump. Each of these engines has eight cylinders, 29.92-in. diameter and 52.76-in. stroke, the total output being about 5,350 b.h.p. at 110 r.p.m.

The auxiliary equipment comprises three sets of Werkspoor four-cycle single-acting engines, coupled to generators with a total output of 540 kw. at 300 r.p.m. These supply current for the whole of the auxiliary machinery in the engine-room and on deck, and in the case of the latter attention has been drawn above to the large cranes which were fitted.

It is in the machinery space that the principal contrast between the new and the old ships arises, for although the total output on a single screw is not much greater, namely, 6,000 b.h.p., the method by which this power is obtained is totally different, for a six-cylinder double-acting two-cycle Stork Hesselman airless-injection engine is fitted.

This in a way is the modern tendency for single-screw ships of medium powers. A six-cylinder double-acting two-cycle engine takes the place of an eight-cylinder single-acting engine, and in view of the fact that the double-acting engine is of airless-injection type there should be some difference in fore and aft length of the prime mover, although, like the Werkspoor-Sulzer engine, the Stork-Hesselman unit will drive its own scavenge pump from a forward extension of the crankshaft.

This engine is a type which has achieved considerable popularity in Holland for ocean-going ships during the last few years, many important vessels having been fitted since the Norwegian-owned Berganger went on service from the yard of the Netherland Shipbuilding Company in August, 1933. Little opportunity for further use of this or any other kind of engine took place during the slump period, however, so that it is worth noting that now conditions have improved in Holland, this particular type of unit is again to the fore. On the other hand, it will be observed that the Netherland Shipbuilding Company, in its new order for a large triple-screw 22 knot passenger liner for the Java trade is still faithful to the Sulzer type.

Taking into consideration the differences in machinery between the new Java-China-Japan Line ship and the older unit, it may be assumed that in general the design of the new ship will not depart very much from that of her predecessors. Indeed, it has been drawn up after considerable experience in the special requirements of this trade. It is to be noted that the new ship carries slightly more passengers, however, for the *Tjinegara* had accommodation for 28 first class, 42 second and about 94 third class passengers.

Rather a peculiar arrangement of superstructure is employed in these vessels, which have four cargo holds, two forward and two abaft the machinery space. There is also a deep tank immediately abaft the engine-room. The *Tjinegara* is virtually a three-island ship, with a long poop housing the third class passengers, but this poop is connected to the bridge deck structure by a superstructure or what in effect amounts to an awning deck.

The second class passengers are carried on the awning or upper deck, most of their accommodation being on that part of the structure which connects the poop and the bridge erection. The second class dining-saloon is on the port side at the after end of this portion of the structure, while the cabins are on the starboard side.

Amidships on the " bridge " deck itself are quarters for the engineer officers on the port side, and for first and second class passengers on the starboard side. The first class dining-saloon is at the forward end of this deck, and here also are four first class cabins, though the first class passengers are mainly accommodated on a promenade deck above this, where there is also a deck saloon at the forward end and a glassed-in promenading space.

An important feature of the whole of the passenger accommodation is the ease of access between all points in the service and passenger quarters without the necessity of going on deck. These, in association with a very efficient heating system, have obviously been arranged for cold weather service in Chinese waters. Above the promenade deck is a small bridge deck containing quarters for the captain and places for four life-boats.

The *Tjinegara* and her sister ship have a straight stem, single funnel amidships, slightly raked, and two pole masts, the foremast having five houses at its base, joined by a structure right across the ship. The two masts each have four derricks, and the former has one for heavy lifts in addition, but the complement of derricks is supplemented by four pairs of electric cranes, two at the break of the forecastle, two at the forward end of the bridge structure, two on the awning deck abaft amidships, and two on the poop.

Important New Publication

(Continued from page 243)

thoroughly reformed and telephone and telegraph lines expanded, thus practically obliterating the distance and time in communication ; schools have been carefully modernized and universalized ; and the new order of things has been felt in almost every walk of life. With it all, it keeps on changing.

And yet, the basic knowledge of those unprecedented changes remain practically sealed to the Western world, largely on account of the language barrier, and a need has been continuously felt everywhere for a medium which can faithfully translate them into an international language.

Contemporary Manchuria has been conceived for the purpose of filling just such a need. It utilizes the cream of voluminous materials, the fruits of a far-flung network of scholarly researches and intelligence activities which are being carried on under various wings of the South Manchuria Railway Company. By its very nature, therefore, it proposes to present factually the most important phases of changes and developments in contemporary Manchuria. Necessarily, it is not a magazine of opinions.

Contemporary Manchuria is the only magazine of its kind in the English language and I confidently believe that it will become, together with our biennial " Report on Progress in Manchuria," an indispensable source in the study and understanding of changing contemporary Manchuria.

Mr. Dai Enki Quits C.N.A.C.

AFTER five years' service with the China National Aviation Corporation, during which period he saw the operation expenses change from an annual deficit of over $480,000 to an estimated profit at the close of the current fiscal year of $500,000, Mr. Dai Enki, Vice-President and Managing Director of the company, has now resigned. Mr. Dai joined the firm in December, 1932, three years after its formation, and is now being transferred by the Ministry of Communications.

It is understood that his place in the firm will be taken by Colonel Ling Yuei-shing, of the Chinese Air Force. During his period of office, Mr. Dai has seen the company expand to an enormous degree, the linking of the Shanghai-Canton route with the trans-Pacific Clipper service affording him especial cause for satisfaction. Mr. Dai has addressed a letter to his fellow colleagues in the company, which reads as follows :

" Carrying out the transfer order of the Ministry of Communications, I take the liberty to tender you this farewell letter and beg to offer, in the following, my humble opinion for your consideration.

" On assuming charge of this office, the company was operating at an annual deficit of more than $480,000, but at the end of the coming fiscal year the company will have an estimated profit of more than $500,000. There has been some criticism of the company, as there will always be of any similar enterprise, yet the irrefutable fact remains that C.N.A.C.'s. record is ' Safety First,' economy and profit building. The following facts should be given the widest publicity for the C.N.A.C. :—

" The C.N.A.C. to-day is flying considerably more than 60 per cent of all the commercial air transport in this country. It is significant that no other aviation enterprise of importance in the world has a record in any way comparable with that of the C.N.A.C.

" During the last five years the C.N.A.C. has carried more than 41,000 passengers without the loss of a single Chinese, and only one foreign passenger fatality. This is a record, that no similar aviation enterprise in the world can equal.

" The C.N.A.C. is the only large air transport company in the world which is operating without government subsidy.

" The credit of all these should be given to the wise and far-sighted policy of the board, the sincere co-operation of the American associates and the untiring efforts of all staffs of this corporation. To my great satisfaction, in addition to the above success, the recent inauguration of the trans-Pacific air service by the Pan-American Airways system linking up with our Shanghai-Canton route at Hongkong and thus bringing China and the United States closer by air, sets a new record in the history of communications of this country.

" From the little experience accumulated during these four and a half years with the corporation, I may be permitted to conclude that the success of the company's business depends entirely on the close co-operation from all sides and co-ordination among staffs. Most of the staffs have been in this company for years and all of them, as you know, are working hard and willingly.

" In order to facilitate the smooth working in all departments of this corporation, it is absolutely necessary that the security of the staffs be maintained. It is unwise to follow, in a commercial enterprise, the practices of the political organization.

" I am very happy of the C.N.A.C.'s record and feel that my countrymen may also feel the same. I hope that the C.N.A.C. will go on under the management of my successor to ever greater success, and I avail of this opportunity to express also my sincere gratitude for courteous assistance so readily given to me from time to time during these four and a half years."

HOW TO MAKE GRAVEYARDS

(Continued from page 212)

the minds of some Chinese that Germany is not specially friendly toward Japan, but accepted the recent treaty solely for purposes of trade expansion. These are just straws, but they blow in the wind in China and find lodgment in most singular ways.

The Kuomintang and the Communists

It is to be observed that since the Sian incident particularly, but also through some months preceding that incident, armed activities of Chinese troops against Chinese communist forces within the country had come to a standstill. Of all the elements within China that have been and continue to press for war with Japan, the Communists and the Leftists in the Government are the most insistent and vociferous. It is to be noted in this connection that the Communists have been successful to a degree in thrusting their influence and their doctrine into the schools all over China, as well as among the masses of workers in the principal centers of the land. This element certainly has a large control over popular clamor. Unquestionably, this force is playing an important and significant part in the events now taking place in China, if not with material support from the Soviet Government, then with the blessing and good-will of Moscow. And, with or without formal truce agreement, fighting against Communist armed forces has ceased.

Though no armistice between the Nanking Government and the Chinese Communist Party has been announced in any formal manner, conditions that have arisen recently leave no doubt that the long drawn-out strife between Government troops and Chinese Communist forces has come to a definite conclusion. A union of these hitherto warring forces, perhaps under nominal control of the Nanking Government, is a development highly probable in the immediate future. Significant parallels are to be found in peace terms proposed by the Chinese Communist Party in a telegram sent recently to the Kuomintang Central Executive Committee with the terms set forth in a resolution of the Kuomintang Executive Committee for reconciliation with the Communists.

The five conditions for peace that were listed in the telegram of the Chinese Communist party were in substance as follows :

(1) Suspension of all civil war in China and concentration of national strength for resistance to external aggression.
(2) Granting of freedom of speech, assembly and organization, and release of political prisoners.
(3) Convocation of a congress of all parties, military groups and organizations to select leaders to carry out salvation of the country.
(4) Immediate preparation for a war of resistance against Japan.
(5) Amelioration of living conditions of the people.

Four conditions for peace with the Chinese Communists set forth in the Resolution of the Kuomintang Executive Committee were :

(1) Abolition of the Red Army and its incorporation into the nation's armed forces under unified command.
(2) Unification of Government power in the hands of the Central Government and dissolution of the so-called Chinese Soviet Republic and other organizations detrimental to Government unity.
(3) Complete cessation of Communist propaganda.
(4) Stoppage of the class struggle.

Can there be any doubt that the elements represented in the foregoing expressions, that in the past have warred against each other so mercilessly, have at length found some common ground on which to stand together ? And can there be any doubt about the gravity of the possible consequences of such a union ?

It is this state of affairs that has increased the burdens of Chiang Kai-shek and has strengthened the position of the chauvinists, who, with no thought of practical realities or the fate of many thousands of their countrymen, seek to upset every common-sense plan for the safety of the people and the salvation of the nation. These pseudo-patriots, in short, to avenge wrongs susceptible of being righted peacefully and advantageously, in order to destroy, or attempt to destroy their foes, are ready to sacrifice their nation and themselves. The greatest gain they could achieve, even if their every hope of victory were realized, would be to see their nation brought under the shadow of an alien influence more sinister than any that ever before has menaced it.

The way to peace is wide open and it leads to prosperity and eventual adjustment of past wrongs. Japan has taken the realistic view. Her proposal, in neighborly terms, briefly, is : " Call quits to strife and bickering. Stop hell-raising so we can get some work done and so that both of us may profit."

It sounds like a fair offer.

Engineering Notes

INDUSTRIAL

NEW SMELTER.—The Yawata Foundry of the Japan Iron Manufacturing Company has decided to build a 1,000-ton smelter, in addition to one of the same capacity now in course of construction. The cost is estimated at Y.7,000,000, and the object is to relieve the present "famine" of pig iron and to prevent foreign pig iron from being imported.

LUMBER MILL.—The establishment of a lumber mill at Hankow to turn out sleepers for the use of various railways in China, are among the latest projects of Mr. Chang Kia-ngau, Minister of Railways. The lumber produced in Kiangsi is suited for sleepers. It will undergo a special chemical process at the proposed mill and will then be made into sleepers.

JAPAN FUEL.—Establishment of the Japan Fuel Industry Company, planned by prominent business men, looked hopeless until the gradual rise of gasoline prices, made the promoters decide to revive the plan. The company is to reduce its capital from Y.5,000,000 to Y.2,000,000, and will build a factory consuming 100,000 metric tons of Horonai coal at Iwamizawa, the Hokkaido to manufacture liquefied coal.

BIG RESERVOIR.—Work started some time ago on a new water reservoir for Tokyo. It will take seven years to construct and cost over £2,120,000. The project will take in the water of the main course of the Tama River and will be about six and a half times as large as the present Murayama and Yamaguchi reservoirs put together. It will impound 6,600,000,000 cubic feet of water. The dam will be 500 feet high, ranking third in the world in this respect.

ALCOHOL FROM GRAIN AND LUMBER.—Recent developments in Manchoukuo include a plan to extract alcohol from grain and lumber. Mr. Yasoichi Mine, of Mukden, is responsible for the scheme to manufacture alcohol as a fuel substitute, using lumber, kaoliang and other materials and working with a Krupp patent to be bought for about Y.5,000,000. Extraction of alcohol from kaoliang has been successful in the laboratory of the South Manchuria Railway Company, but the method has never been worked out on an industrial scale. Final plans will be announced by June.

DIESEL AUTOS PLANNED.—Manufacture of diesel-engined automobiles in Japan has already gone through a series of experiments with satisfactory results, and will be taken up in earnest by several companies, such as the Mitsubishi Heavy-Industries, Ikegai Iron Works, Niigata Iron Works, Hitachi Works, and others. The Ikegai Works is building a diesel-engine automobile plant at Kawasaki, at a cost of Y.1,500,000. Niigata Works has decided to enlarge its Kamata factory for the purpose, and Mitsubishi will construct a new plant at Maruko. Hitachi, too, is planning to build a factory at Sukekawa.

HUGE COAL PLANT.—A contract valued at about £1,000,000 has been concluded between M. Kato, the Manchoukuo Trade Commissioner in Berlin, and a German concern for the supply of a coal-vibration plant to Manchoukuo. Delivery will extend over several years.

One-fifth of the total sum is being paid for licence to manufacture synthetic petrol from coal by the Fischer method. Other major transactions are under consideration. They include locomotives and blast furnaces.

A new German Trade Commissioner will, it is reported, leave for Manchoukuo shortly.

COAL LIQUEFACTION EXPERIMENT.—The immediate construction of an experimental coal liquefaction plant at Fushun, capable of producing 20,000 tons of oil annually, was decided at a conference of South Manchuria Railway officials held at Dairen some time ago. The plans of the S.M.R., it is stated, provide for the building of a factory capable of ultimately supplying the demand of the entire Japanese nation, which to-day is estimated at 3,500,000 tons, the bulk of which is now supplied by foreign concerns. The coal liquefaction process, it is stated, is entirely Japanese, and the machinery to be installed in the plants will be almost exclusively Japanese. It is understood, however, that the British coal hydrogenation process for the production of oil will be incorporated in the plant at Fushun.

NEW SMELTERS.—The Tokyo Minister of Commerce and Industry has sanctioned construction of new smelters by the Japan Iron Manufacturing Company, the Japan Steel Tubing Company, and the Asano Shipbuilding Iron Department. Japan Iron will build a 1,000-ton smelter at its Yawata Foundry. Asano intends to build a 300-ton smelter at Tsurumi. Japan Steel Tubing Company is building two 400-ton smelters at its Kawasaki plant. The company is also planning to build two 500-ton installations and application for permission to do so will be filed shortly. The new smelters will cost about Y.15,000,000, and equipment for disposing of by-products will require another Y.5,000,000. Japan Steel Tubing, therefore, plans to call in Y.25,000,000 unpaid shares. The Ministry of Commerce and Industry has decided to organize an Iron Manufacturing Investigation Commission, in preparation for a remodelling of the Government policy for iron manufacturing. The Ministry wants to establish a definite policy with regard to acquisition of raw materials. It would also have the Government control imports of iron ore and scrap iron.

KOREAN TEXTILE MILL.—The Dai Nihon Spinning Company, Osaka, has decided to build a mill at Eitoho, near Seoul, and has purchased a 20,000 Tsubo site. Construction is expected to be started shortly.

YOKOHAMA INDUSTRIAL HALL.—Yokohama will have a large and well equipped building devoted to the industrial activity of the port. According to the tentative program, Yokohama will appropriate Y.250,000 toward the cost of the building, while the Y.150,000 necessary to equip it will be raised by public subscription. The vacant ground opposite Yokohama Station has been selected as the site. The structure will be used to display heavy and light machinery used in the port, of both domestic and foreign make. An auditorium will be used as a training school for industrial workers. There will also be a library of data on the industry of the world.

RAILWAYS

NEW RAILWAY LINK.—Shaohsing, famous for its wine and rice, it is expected, will be linked by rail with Hangchow, the Chekiang provincial capital, in August, when the southeastern extension of the Shanghai-Hangchow-Ningpo Railway will be thrown open to traffic.

Shaohsing, lying about 30 miles to the south-east of Hangchow, is at present connected with the Chekiang capital by canal.

NEW RAILWAY LOAN.—It is announced that a French syndicate is to lend $34,500,000 (about £2,160,000) in materials and cash for the construction of 523 kilometers (325 miles) of railway between Chengtu and Chungking, traversing the richest part of Szechuen Province.

The balance of $20,000,000 (about £1,250,000) will be furnished by the new Chuanchien Railway Company, which will operate the line as a private concern.

The loan is redeemable in 15 years and is guaranteed unconditionally by the Ministry for Railways.

NEW RAIL CONTRACT.—An agreement involving the purchase of £900,000 worth of British railway material has been initialled between Messrs. Jardine Engineering Corporation and the Chinese Ministry of Railways.

This is to equip the new King-Kan (Nanking-Kiangsi) Railway, which will connect Nanking for the first time by railway with Canton and Hongkong.

The total length of the new line to be built is about 300 miles. It will open up some of the most fertile parts of Central China, particularly in Kiangsi, where the Government has been making great efforts to resuscitate the farmers since the expulsion of the Communists in 1934.

SHIPPING

CANTON HARBOR IMPROVEMENT.—Pending the approval of Nanking authorities, a conservancy surtax is to be imposed by the Canton Customs to finance the project of improving the silt situation near Canton Harbor. The project requires a sum of $3,000,000, and the work is expected to be completed in three years, when vessels with a draught of 20 feet will be able to navigate the harbor without difficulty.

DEVELOPMENT OF HAINAN.—The Kwangtung authorities have formulated plans to develop Hainan Island, the noted fruit area and the largest isle off the south coast. In addition to hastening completion of the highway network and the construction of several piers, the Government has planned a round-the-coast railroad. The project has been drawn up by a Dutch railway engineer, and the Ministry of Railways has already been approached for a part of the Sino-British Boxer fund for the construction of the projected line.

WHAMPOA HARBOR.—The U.S. $2,000,000 bond issue for the development of the Whampoa Harbor and the dredging of the Pearl River in Kwangtung has been approved by the Legislative Yuan. The bonds were issued some time ago at the face value of 98 with an interest of 6 per cent per annum.

With the payment of interest and repayment of principal twice a year, namely on March 31 and September 30, the bond issue will be redeemed in 16 years, namely on March 31, 1953.

A surcharge of 5 per cent to be imposed by the Customs for imports into Kwangtung will be levied as security for the loan.

The Central Bank of China is designated as the sole agent and supervisor for affairs relating to payment of interest and repayment of principal of the loan.

The bonds are of three denominations, namely $5,000, $1,000 and $100, and may be transferred, mortgaged or used as security in public transactions.

HULUTAO HARBOR PROGRESS.—Hulutao harbor facilities, now under construction, will be completed in 1939, at the cost of more than $16,000,000. With the improvement of the Lienshan-Hulutao Railway and the construction of warehouses, the harbor will then be able to handle annual exports of 1,370,000 tons of coal and 530,000 tons of general cargo. Construction of the harbor, which faces Liaotung Bay, was begun years ago by Netherlands Harbor Works under a contract awarded by the old Mukden Government.

COMMUNICATIONS

NEW WEATHER STATIONS.—Definite expansion of Japan's weather forecasting facilities is planned by the Communications Ministry, which has placed an item of Y.340,000 in its budget for the current fiscal year to cover it. At present, despite the increase of Japan's air lines and projected additions, there is no weather station between Japan Proper and Formosa. Meteorological stations are to be erected at Tomie, Nagasaki Prefecture, Ishigaki Island, Okinawa Prefecture, and at an undecided point in Miyazaki Prefecture.

HSIANG RIVER BRIDGE.—Construction of the railway from Kweichow to Hunan officially began last October. One of three lines intended to bind the western provinces to the Central Government, the new railway will run between Kweiyang and Chuchow, meeting the Hankow-Canton Railway at the latter point. The Kweiyang-Yunnanfu and Kweiyang-Chengtu railway projects will be undertaken when the Kweiyang-Chuchow railway is completed. The latter, fully surveyed, will cover 1,100 kilometers. At Siangtan the soil has been upturned for the first bridge across the Hsiang River. The structure, one of three large bridges on the route, will be built with American imported steel. The engineers plan to complete the span in about eighteen months.

NEW HIGHWAYS.—To develop communications in northern Shensi, the provincial authorities are planning the construction of two new highways linking Yulin with Tunghsieng and Suiteh. The cost is estimated at $300,000.

HIGHWAY DEVELOPMENT.—Instructions have already been received in Chengtu, from the Central Government, to the effect that $5 million be allotted from the $15 million Szechuen Rehabilitation Loan for highway construction. Two trunk highways will be built, one linking Chengtu with Kunming, capital of Yunnan, and the other connecting Szechuen with Sikong province. Plans have been made for the repair of the Chengtu-Kweiyang highway which, it is estimated, will cost approximately $440,000.

NEW BRIDGES.—The Chinese Ministry of Railways has decided to construct a steel bridge across the Yellow River at Tungkwan on the Shansi-Honan border to facilitate through traffic between the Lunghai Railway and the Tatung-Puchow line. To be one kilometer in length, the bridge will cost approximately $3 million, and construction is to be completed within two years.

The steel bridge of the Nanchang-Kiukiang Railway across the Kan River between Nanchang and Niuhsing Stations was ready for traffic some time ago. The cost of this bridge is $280,000.

LONG DISTANCE 'PHONE.—Two important long-distance 'phone services, the Hunan-Kiangsu and the Hunan-Honan lines, constructed under the auspices of the Ministry of Communications, officially inaugurated some time ago.

The first line will link Shanghai with Changsha by way of Yoyang, Chinkiang, Wusih and Soochow, while the second line will pass through Yoyang, Hsinyang, Hsuchang, Loyang, Kaifeng and Chengchow.

The rates for the calls have been completed by the Ministry of Communications and have been announced already.